THE SILVA
OF NORTH AMERICA

BY

PROF. CHARLES S. SARGENT

Publishers' Announcement

As it has been found impracticable to include in this twelfth volume of Professor Sargent's great work the general Index to the entire work, a thirteenth volume, containing this Index, together with descriptions and illustrations of recently discovered species, and such corrections of the original volumes as recent explorations have made necessary, will be sent to subscribers *without charge*, as soon as ready.

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THE
SILVA OF NORTH AMERICA

A DESCRIPTION OF THE TREES WHICH GROW NATURALLY IN NORTH AMERICA EXCLUSIVE OF MEXICO

BY

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DIRECTOR OF THE ARNOLD ARBORETUM
OF HARVARD UNIVERSITY

Illustrated with Figures and Analyses drawn from Nature

BY

CHARLES EDWARD FAXON

VOLUME XII

CONIFERÆ

(Abietineæ after Pinus)

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18150

TO

WILLIAM MARRIOTT CANBY

THIS TWELFTH VOLUME OF

THE SILVA OF NORTH AMERICA

IS AFFECTIONATELY DEDICATED

BY HIS COMPANION IN MANY JOURNEYS THROUGH

THE FORESTS OF THE CONTINENT

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SYNOPSIS OF THE ORDERS OF PLANTS CONTAINED IN VOLUME XII. OF THE SILVA OF NORTH AMERICA.

CLASS III. **GYMNOSPERMÆ. Resinous trees or shrubs.**

Stems increasing in diameter by the annual addition of a layer of wood inside the bark. Flowers unisexual, naked. Stamens numerous. Ovules 2 or many not inclosed in an ovary. Cotyledons 2 or more. Leaves usually straight-veined, persistent, or deciduous.

58. **Coniferæ.** Flowers monœcious, usually solitary, terminal, or axillary. Ovules 2 or many. Fruit a woody or rarely fleshy strobile. Cotyledons 2 or many. Leaves scale-like, linear or subulate, solitary or clustered.

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SILVA OF NORTH AMERICA.

LARIX.

Flowers solitary, naked, monœcious, the staminate axillary; stamens indefinite, anther-cells 2, surmounted by their connective; the pistillate terminal, ovules 2 under each scale. Fruit a woody strobile, maturing in one season. Branchlets dimorphic. Leaves scattered or fascicled, deciduous.

Larix, Adanson, *Fam. Pl.* ii. 480 (1763). — Link, *Abhand. Akad. Berl.* 1827, 183. — Engelmann, *Trans. St. Louis Acad.* ii. 211. — Bentham & Hooker, *Gen.* iii. 442. — Eichler, *Engler & Prantl Pflanzenfam.* ii. pt. i. 75. — Masters, *Jour. Linn. Soc.* xxx. 31.

Pinus, Linnæus, *Gen.* 293 (in part) (1737). — Endlicher, *Gen.* 260 (in part). — Meisner, *Gen.* 352 (in part). — Baillon, *Hist. Pl.* xii. 44 (in part).

Abies, A. L. de Jussieu, *Gen.* 414 (in part) (1789).

Tall pyramidal trees, with thick sometimes furrowed scaly bark, hard heavy heartwood conspicuously marked by dark bands of summer cells impregnated with resin, thin pale sapwood, slender remote horizontal and often pendulous branches, elongated leading branchlets roughened by persistent leaf-scars, usually short thick spur-like lateral branchlets disappearing at the end of a few years or occasionally developing into vigorous branches. Buds small, subglobose, covered by numerous broadly ovate thin chestnut-brown lustrous scales, those of the lower pair lateral and opposite, the others spirally disposed; outer scales accrescent, marking the lateral branchlets with prominent ring-like scars, the inner deciduous with the appearance of the leaves and the falling of the staminate flowers.[1] Leaves linear-subulate, triangular and rounded above or rarely tetragonal, keeled and stomatiferous below, articulate on low persistent ultimately woody bases, containing single fibro-vascular bundles, and two resin canals in their lateral angles close to the epidermis, slightly incurved in the bud, deciduous; spirally disposed and remote on leading shoots, on short lateral branchlets in crowded fascicles, each leaf in the axil of a minute deciduous bud-scale. Flowers monœcious, solitary, terminal, the staminate on leafless, the pistillate on leaf-bearing lateral branchlets of the previous or of an earlier year, surrounded at the base by the reflexed inner bud-scales. Staminate flowers globose, ovoid or oblong, sessile or pedunculate, composed of numerous spirally arranged short-stalked two-celled subglobose anthers opening longitudinally, their connectives produced above them into short points or gland-like umbos; pollen-grains globose. Pistillate flowers appearing with the leaves, subglobose, subsessile, composed of few or numerous spirally arranged suborbicular stipitate scales bearing on their inner face near the base two naked collateral inverted ovules, each scale in the axis of a much longer mucronate membranaceous usually scarlet bract, the lowest bracts without scales and roughening with their persistent tumid closely imbricated bases the stalks of the cones. Fruit an ovoid oblong conical or subglobose short-stalked cone, at first nearly horizontal, finally assurgent by the incurving of the stout stalk, composed of the slightly thickened woody suborbicular or oblong-obovate closely or loosely imbricated concave scales of the flower, more or less erose on the margins, often longitudinally striate, longer or shorter than their bracts, gradually decreasing in size from the centre of the cone to the ends, the small scales usually sterile, persistent on the central axis of the cone after the escape of the seeds. Seeds geminate, reversed, attached at the base in shallow depressions on the inner face of the scales, nearly triangular, rounded on the sides, in falling bearing away portions of the membranaceous lining of the scale forming oblong or obovate-oblong wing-like attachments longer than the seeds; testa of two coats, the outer crustaceous, light brown, the inner membranaceous, light chestnut-brown and lustrous. Embryo axile in copious fleshy albumen; cotyledons usually six, much shorter than the inferior radicle.

Larix is now widely distributed over the boreal and mountainous regions of the northern hemisphere, ranging from the Arctic Circle to the mountains of Pennsylvania in the New World and to latitude 30° in the Old World. Eight species are recognized; one inhabits northeastern North America, and two western North America; one[2] grows on the mountains of central Japan and another[3] on the eastern Himalayas; on the mountains of central Europe there is one species,[4] another[5] forms great forests on the plains of northern Russia and eastern Siberia, and eastward is replaced by another species[6] which extends to Saghalin, northern Japan, and the Kurile Islands. The type is an ancient one, and its fossil remains have been found in miocene rocks of central Europe.[7]

Larix produces hard, durable, valuable timber, which is often of great commercial importance, turpentine, which is sometimes used in medicine,[8] tar,[9] bark rich in tannin,[10] and a peculiar manna-like substance.[11]

Larix is preyed on by numerous destructive insects[12] and by serious fungal diseases.[13]

Some species are considered valuable ornamental trees, and are often planted in northern countries for the decoration of parks.

Larix, the classical name of the Larch-tree, was adopted by Tournefort,[14] but was included by Linnæus in his genus Pinus.

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[1] Henry, *Nov. Act. Acad. Cæs. Leop.* xix. 98, t. 13; xxii. 246, t. 22.

[2] *Larix Kæmpferi* (not Gordon).

Pinus Larix, Thunberg, *Fl. Jap.* 275 (not Linnæus) (1784).

Pinus Kæmpferi, Lambert, *Pinus*, ii. Preface, p. v. (1824).

Abies Kæmpferi, Lindley, *Penny Cycl.* i. 34 (1833).

Abies leptolepis, Siebold & Zuccarini, *Fl. Jap.* ii. 12, t. 105 (1842).

Pinus leptolepis, Endlicher, *Syn. Conif.* 130 (1847). — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 410.

Larix Japonica, Carrière, *Traité Conif.* 272 (1855).

Larix leptolepis, Gordon, *Pinetum*, 128 (1858). — A. Murray, *Proc. R. Hort. Soc.* ii. 633, f. 154, 156–160; *The Pines and Firs of Japan*, 89, f. 172–177. — Miquel, *Ann. Mus. Bot. Lugd. Bat.* iii. 166 (*Prol. Fl. Jap.*). — Regel, *Gartenflora*, xx. 102, t. 685, f. 5; *Act. Hort. Petrop.* i. 158; *Belge Hort.* xxii. 100, t. 8, f. 2. — Franchet & Savatier, *Enum. Pl. Jap.* i. 466. — Masters, *Jour. Linn. Soc.* xviii. 522 (*Conifers of Japan*). — Trautvetter, *Act. Hort. Petrop.* ix. 212 (*Incrementa Fl. Ross.*). — Mayr, *Monog. Abiet. Jap.* 63, t. 5, f. 14. — Beissner, *Handb. Nadelh.* 318, f. 83.

The Japanese Larch, which is a tree seventy or eighty feet in height, with a massive trunk from three to four feet in diameter, and pale blue-green foliage, is common on the mountains of central Hondo at elevations of from five to six thousand feet above the sea-level, where it is scattered usually in small groves through forests principally composed of Birches, Oaks, and Hemlocks. The hard durable wood, difficult to obtain from the inaccessible mountain forests, is used locally for the timber of mines and in the manufacture of many small articles. (See Rein, *Industries of Japan*, 238. — Sargent, *Forest Fl. Jap.* 83.)

Larix Kæmpferi was introduced about forty years ago into the gardens of Europe and the northeastern United States, where it is hardy and vigorous and is chiefly distinguished by the brilliant yellow color assumed by its leaves in autumn.

At the upper limits of tree growth, at elevations of between eight and nine thousand feet above the sea, a low form of this Larch, dwarfed by cold, with shorter leaves and smaller cones, grows on Mt. Fugi-san. This is

Larix Kæmpferi, var. *minor*.

Abies leptolepis, Lindley, *Gard. Chron.* 1861, 23 (not Siebold & Zuccarini).

Larix leptolepis, var. *minor*, A. Murray, *Proc. R. Hort. Soc.* ii. 633, f. 155 (1862).

Larix Japonica, A. Murray, *The Pines and Firs of Japan*, 94, f. 178–188 (not Carrière) (1863). — Regel, *Gartenflora*, xx. 104, t. 685, f. 7; *Act. Hort. Petrop.* i. 159; *Belge Hort.* xxii. 103, t. 9, f. 4.

Larix leptolepis, β *Murrayana*, Maximowicz, *Ind. Sem. Hort. Petrop.* 1866, 3 (*nomen nudum*). — Franchet & Savatier, *l. c.* — Beissner, *l. c.* 319, f. 84. — Masters, *Jour. R. Hort. Soc.* xiv. 217.

Larix Japonica macrocarpa, Carrière, *Traité Conif.* ed. 2, 354 (1867).

[3] *Larix Griffithii*, Hooker f. *Ill. Him. Pl.* t. 21 (excl. staminate flowers) (1855); *Fl. Brit. Ind.* v. 655. — Van Houtte, *Fl. des Serres*, xii. 165, t. 1267. — Gordon, *Pinetum*, Suppl. 39; ed. 2, 171. — Regel, *Gartenflora*, xx. 106, t. 685, f. 1–4; *Act. Hort. Petrop.* i. 161; *Belge Hort.* xxii. 105, t. 10, f. 4–7. — Brandis, *Forest Fl. Brit. Ind.* 531. — Beissner, *l. c.* 316, f. 82.

Larix Griffithiana, Carrière, *Traité Conif.* 278 (1855). — Gordon, *Pinetum*, 126.

Pinus Griffithii, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 411 (1868).

Larix Griffithii, which is a tree from twenty to sixty feet in height, with long gracefully pendulous branches and elongated cones made conspicuous by long exserted deep orange-brown bracts, is scattered over the inner mountain ranges of Bhotan, Sikkim, and eastern Nepal at elevations of between eight and twelve thousand feet above the sea-level, growing usually near the heads of valleys on moraines, which it covers with scanty forests, and occasionally on well-drained grassy slopes. (See Hooker f. *Himalayan Journals*, new ed. i. 245; *Gard. Chron.* n. ser. xxv. 718, f. 157. — Gammie, *Rec. Bot. Surv. Ind.* i. No. 2, 11.) The wood, which is considered more durable than that of the other Himalayan conifers, is exported from Sikkim and Thibet. (See Gamble, *Man. Indian Timbers*, 410.)

Introduced into England in 1848, the Himalayan Larch has rarely flourished in cultivation, although occasionally a plant in some exceptionally favorable situation in Europe shows the beauty and interest of this tree as a garden ornament. (See *Gard. Chron.* n. ser. xxvi. 464, f. 95. — *Bull. Soc. Tosc. Ort.* xvii. 312.)

[4] *Larix Larix*, Karsten, *Pharm.-med. Bot.* 326, f. 157 (1882).

Pinus Larix, Linnæus, *Spec.* 1001 (1753). — Pallas, *Fl. Ross.* i. 1 (in part), t. 1, f. A, B. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 22. — Ledebour, *Fl. Ross.* iii. 672. — Reichenbach, *Icon. Fl. German.* xi. 4, t. 532 (*Larix Europæa* on plate). — Christ, *Verhand. Nat. Gesell. Basel*, iii. 546 (*Uebersicht der Europäischen Abietineen*). — Parlatore, *Fl. Ital.* iv. 59; *De Candolle Prodr.* xvi. pt. ii. 411.

Larix decidua, Miller, *Dict.* ed. 8, No. 1 (1768). — K. Koch, *Dendr.* ii. pt. ii. 258.

Larix caducifolia, Gilibert, *Exercit. Phyt.* ii. 413 (1792).

Pinus læta, Salisbury, *Prodr.* 399 (1796).

Abies Larix, Poiret, *Lamarck Dict.* vi. 511 (1804); *Ill.* iii. 368, t. 785. — *Nouveau Duhamel*, v. 287, t. 79, f. 1. — Richard, *Comm. Bot. Conif.* 65, t. 13. — Lindley, *Penny Cycl.* i. 32, f.

Larix Europæa, De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 277 (1805). — Link, *Linnæa*, xv. 534. — Schouw, *Ann. Sci. Nat.* sér. 3, iii. 241 (*Conifères d'Italie*). — Carrière, *Traité Conif.* 276. — Fiscali, *Deutsch. Forstcult. Pfl.* 36, t. 1, f. 21-28. — Gordon, *Pinetum*, 124. — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 90. — Colmeiro, *Enum. Pl. Hispano-Lusitana*, iv. 709. — Herder, *Act. Hort. Petrop.* xii. 102 (*Pl. Radd.*); *Bot. Jahrb.* xiv. 160 (*Fl. Europ. Russlands*). — Hempel & Wilhelm, *Bäume und Sträucher*, i. 109, f. 53-57, t. 3.

Larix pyramidalis, Salisbury, *Trans. Linn. Soc.* viii. 314 (1807).

Larix Europæa communis, Lawson & Son, *Agric. Man.* 386 (1836).

Larix Europæa laxa, Lawson & Son, *l. c.* (1836).

Larix Europæa compacta, Lawson & Son, *l. c.* (1836).

Larix vulgaris, Spach, *Hist. Vég.* xi. 432 (1842).

Pinus Larix, *α communis*, Endlicher, *Syn. Conif.* 134 (1847).

Pinus Larix, *δ laxa*, Endlicher, *l. c.* (1847).

Pinus Larix, *ε compacta*, Endlicher, *l. c.* (1847).

Pinus Larix, *η rubra*, Endlicher, *l. c.* (1847).

Pinus Larix, *θ rosea*, Endlicher, *l. c.* 134 (1847).

Pinus Larix, *ι alba*, Endlicher, *l. c.* 134 (1847).

Larix decidua, *α communis*, Henkel & Hochstetter, *Syn. Nadelh.* 130 (1865). — Regel, *Gartenflora*, xx. 100, t. 684, f. 3; *Act. Hort. Petrop.* i. 156; *Belge Hort.* xxii. 98, t. 7, f. 1.

Larix Europæa, *α typica*, Regel, *Russ. Dendr.* pt. i. 28 (1870).

Larix Europæa pendula, Regel, *l. c.* (1870).

Larix communis, var. *δ pendulina*, Regel, *Gartenflora*, xx. 101, t. 684, f. 5, 6 (1871); *Act. Hort. Petrop.* i. 157; *Belge Hort.* xxii. 99, t. 7, f. 5, 6.

Larix Larix, the type of the genus, grows naturally only at high elevations on the mountain ranges of central Europe from southeastern France to Servia and Hungary. In France, either alone or mixed with mountain Pines, it often forms great forests, but in Switzerland and on the Bavarian and Italian Alps it is less abundant, and is usually associated with the Spruce, frequently growing to the upper zone inhabited by trees. The European Larch is from eighty to one hundred or exceptionally one hundred and fifty feet in height, with a tall trunk from three to four feet in diameter, and small spreading often pendulous branches, and produces strong heavy and very durable wood, which has been valued since the time of the Romans, and is largely used for beams, piles, water-pipes, posts, railway-ties, and shingles, in cabinet-making, and for painters' palettes. (See Tour d'Aigues, *Mém. Soc. Agric. Paris*, 1787, 41. — Desfontaines, *Hist. Arb.* ii. 599.)

During the last one hundred and fifty years the European Larch has been largely planted as a timber-tree beyond the limits of its natural home. In Scotland in particular great attention was given to the cultivation of the Larch by the Dukes of Athol on their estates of Athol and Dunkeld, and between 1738 and 1826 they covered about eight thousand acres with pure forests of this tree. (See *Trans. Highland Soc.* xi. 165. — Loudon, *Arb. Brit.* iv. 2359.) In European plantations the Larch has grown with great rapidity while young, and, on the whole, these plantations have produced satisfactory results if the trees have been cut when they were from forty to sixty years of age. Removed from its native forests, however, the Larch produces wood which deteriorates before the tree reaches maturity, and in recent years Larch plantations have suffered seriously from disease and the attacks of insects. (For culture of the Larch in Europe, see Evelyn, *Silva*, ed. Hunter, i. 279. — R. Hartig, *Forst. Culturpfl. Deutschl.* 37, t. 3. — M'Corquodale, *Trans. Scottish Arboricultural Soc.* ii. 43. — Gorrie, *Trans. Scottish Arboricultural Soc.* viii. 61. — Mathieu, *Fl. Forestière*, ed. 3, 485. — Michie, *The Larch.* — McGregor, *Trans. Scottish Arboricultural Soc.* ix. 234. — Lorentz, *Culture des Bois*, ed. 6, 159. — Mer, *Rev. Eaux et Forets*, xxiv. 111 [*Culture du Mélèze dans les Vosges*]. — Schlich, *Manual of Forestry*, ii. 309. — J. B. Carruthers, *Jour. R. Agric. Soc. England*, ii. pt. ii. [*The Canker of the Larch*]. — Somerville, *Trans. English Arboricultural Soc.* ii. 363.)

The European Larch, brought to America probably early in the present century, flourishes in the north Atlantic states, where it grows rapidly to a large size and has proved one of the few European trees which can really be successfully grown in the New World. It has been frequently planted here as an ornamental tree, and occasionally, on a comparatively small scale, for the production of timber. These plantations are still young and have not yet shown the quality of the material which the European Larch can produce in the United States. (See Sargent, *Rep. Sec. Board Agric. Mass.* ser. 2, xxiii. 276. — Warder, *Am. Jour. Forestry*, i. 11.)

A form of the European Larch, with long pendulous branches (*Larix Europæa pendula*, Lawson & Son, *Agric. Man.* 387 [1836]. — Loudon, *Arb. Brit.* iv. 2351. — *Larix decidua*, *ε pendula*, Regel, *Gartenflora*, xx. 102, t. 684, f. 11 [1871]), which is believed to have originated in the Tyrol, is often planted as an ornament of parks; and nurserymen propagate other abnormal forms. (See Beissner, *Handb. Nadelh.* 327.)

[5] *Larix Sibirica*, Ledebour, *Fl. Alt.* iv. 204 (1833). — Link, *l. c.* 535. — Carrière, *l. c.* 274. — Trautvetter, *Middendorff Reise*, i. pt. ii. 170 (*Pl. Jen.*). — Trautvetter & Meyer, *Middendorff Reise*, i.

pt. ii. 88 (*Fl. Ochot.*). — Regel, *Russ. Dendr.* pt. i. 30. — Masters, *Jour. Linn. Soc.* xviii. 523 (*Conifers of Japan*). — Herder, *Act. Hort. Petrop.* xii. 101 (*Pl. Radd.*) ; *Bot. Jahrb.* xiv. 160 (*Fl. Europ. Russlands*).

Pinus Larix, Pallas, *Fl. Ross.* i. 1 (in part), t. 1, f. C (not Linnæus) (1784).

Larix Archangelica, Lawson & Son, *Agric. Man.* 389 (1836). — Trautvetter, *Act. Hort. Petrop.* ix. 211 (*Incrementa Fl. Ross.*).

Larix Europæa, var. *Sibirica*, Loudon, *Arb. Brit.* iv. 2352 (1838).

Larix intermedia, Turczaninow, *Bull. Soc. Nat. Mosc.* xi. 101 (*Cat. Pl. Baical.*) (not Lawson & Son) (1838). — K. Koch, *Dendr.* ii. pt. ii. 260.

Larix Ledebourii, Ruprecht, *Fl. Samojed. Cisural.* 56 (1845). — Gordon, *Pinetum*, 127.

Pinus Ledebourii, Endlicher, *Syn. Conif.* 131 (1847). — Ledebour, *Fl. Ross.* iii. 672. — Turczaninow, *Fl. Baicalensi-Dahurica*, ii. 140. — Herder, *Bull. Soc. Nat. Mosc.* xli. 423. — Christ, *Verhand. Nat. Gesell. Basel*, iii. 546 (*Uebersicht der Europäischen Abietineen*). — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 410.

Larix Altaica, (Nelson) Senilis, *Pinaceæ*, 84 (1866). — Trautvetter, *l. c.*

Larix communis, var. β *Sibirica*, Regel, *Gartenflora*, xx. 101, .. 684, f. 1, 2 (1871) ; *Act. Hort. Petrop.* i. 156 ; *Belge Hort.* xxii. 99, t. 7, f. 2, 3.

Larix communis, γ *Rossica*, Regel, *Gartenflora*, xx. 101, t. 684, f. 4 (1871) ; *Act. Hort. Petrop.* i. 157 ; *Belge Hort.* xxii. 99, t. 7, f. 4.

Larix Rossica, Trautvetter, *l. c.* 212 (1884).

Larix Sibirica, which many botanists have considered a geographical form of the Larch of central Europe, is a large pyramidal tree, and forms great forests on the plains of northern Russia and western Siberia, ranging northward to the seventy-first degree of latitude, and eastward to the Altai Mountains, on which it abounds at elevations of from two thousand five hundred to five thousand five hundred feet above the sea-level. The character of the wood is very similar to that of *Larix Larix* and is used for similar purposes.

[6] *Larix Dahurica*, Turczaninow, *Bull. Soc. Nat. Mosc.* xi. 101 (*Cat. Pl. Baical.*) (1838). — Regel & Tilling, *Fl. Ajan.* 119. — Carrière, *Traité Conif.* 271. — Gordon, *Pinetum*, 123 (excl. syn.). — Trautvetter & Meyer, *Middendorff Reise*, i. pt. ii. 88 (*Fl. Ochot.*). — Maximowicz, *Bull. Phys. Math. Acad. Sci. St. Pétersbourg*, xv. 436 (*Bäume und Sträucher des Amurlands*); *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 262 (*Prim. Fl. Amur.*); *Bull. Soc. Nat. Mosc.* liv. 58. — F. Schmidt, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, xii. 63 (*Reisen in Amurlande*), 177 (*Fl. Sachalinensis*). — K. Koch, *l. c.* — Glehn, *Act. Hort. Petrop.* iv. 86 (*Verz. Witim-Olekma-Lande*). — Masters, *l. c.* 522. — Regel, *Russ. Dendr.* ed. 2, pt. i. 53, f. 13, b. h. — Beissner, *Handb. Nadelh.* 328, f. 90. — Herder, *Act. Hort. Petrop.* xii. 98 (*Pl. Radd.*). — Korshinsky, *Act. Hort. Petrop.* xii. 424 (*Pl. Amur.*).

Pinus Larix (*Americanæ*), Pallas, *Fl. Ross.* i. 2, t. 1, f. E. (1784).

Larix Europæa, var. *Dahurica*, Loudon, *l. c.* (1838).

Pinus Dahurica, Trautvetter, *Imag. Pl. Fl. Russ.* 48, t. 32 (1844). — Ledebour, *Fl. Ross.* iii. 673. — Endlicher, *l. c.* 128. — Turczaninow, *l. c.* — Parlatore, *l. c.*

Larix Europæa, Middendorff, *Bull. Phys. Math. Acad. Sci. St. Pétersbourg*, iii. 255 (not De Candolle) (1845).

Abies Gmelini, Ruprecht, *l. c.* (1845).

Pinus Kamtschatika, Endlicher, *l. c.* 135 (1847).

Larix Kamtschatika, Carrière, *l. c.* 279 (1855). — Gordon, *Pinetum*, Suppl. 39. — Parlatore, *l. c.* 431.

Larix Dahurica, α *typica*, Regel, *Gartenflora*, xx. 105, t. 684, f. 8, 9 (1871) ; *Act. Hort. Petrop.* i. 160 ; *Belge Hort.* xxii. 104, t. 9, f. 5–6.

Larix Dahurica, β *prostrata*, Regel, *Gartenflora*, xx. 105, t. 684, f. 9–10 (1871) ; *Act. Hort. Petrop.* i. 160; *Belge Hort.* xxii. 104.

Larix Dahurica, which is described as a small tree, becoming shrubby and semiprostrate in the extreme north, is generally distributed through eastern Siberia, Kamtschatka, Manchuria, northern China, and Saghalin, and in one form reaches the extreme northern part of Yezo, and the Kurile Islands. This form is

Larix Dahurica, var. *Kurilensis*.

Larix Dahurica, var. γ *Japonica*, Regel, *Gartenflora*, xx. 105, t. 685, f. 6 (not *Larix Japonica*, Carrière) (1871) ; *Act. Hort. Petrop.* i. 160 ; *Belge Hort.* xxii. 105, t. 10, f. 1. — Beissner, *l. c.* 329, f. 91. — Miyabe, *Mem. Bost. Soc. Nat. Hist.* iv. 261 (*Fl. Kurile Islands*). — Sargent, *Forest Fl. Jap.* 84, t. 26.

Larix Kurilensis, Mayr, *Monog. Abiet. Jap.* 66, t. 5, f. 15 (1890).

[7] Saporta, *Origine Paléontologique des Arbres*, 72.

[8] The turpentine of the Larch, usually known in commerce as Venice turpentine, because it was formerly exported from Venice, is a thick pale yellow honey-like fluid with a bitter aromatic flavor. It is collected from *Larix Larix*, chiefly in the Tyrol, by boring in early spring, nearly to the centre of the trunk, a hole about an inch in diameter and a foot above the ground, and firmly closing the hole with a wooden stopper, which is taken out in the autumn, when the turpentine which has collected in the hole is removed with an iron spoon. The hole is then closed again, and the same process is repeated in the following autumn. A hole, which yields about half a pound of turpentine annually, continues to be productive for many years, and, if it is kept carefully closed, does not injure the growth of the tree. Under the more wasteful methods which were long practiced on the Italian and French Alps a much larger annual yield was obtained for a short time from a number of larger holes made in the same tree ; this method, however, soon ceased to be productive, and if the holes were left open in order that the turpentine might flow continuously through wooden pipes into small pails, the value of the wood was soon impaired.

Venice turpentine, once considered a sovereign remedy for many human diseases, is now rarely used except in veterinary practice, and the article sold under that name is usually a mixture of common resin and oil of turpentine. (See Mattioli, *Opera* [*Apologia*, 146]. — Woodville, *Med. Bot.* iii. 576, t. 210. — Loudon, *l. c.* 2366. — Guibourt, *Jour. de Pharm.* xxv. 500 ; *Hist. Drog.* ed. 7, ii. 251. — Mohl, *Bot. Zeit.* xvii. 329. — Flückiger & Hanbury, *Pharmacographia*, 549. — Bentley & Trimen, *Med. Pl.* iv. 260, t. 260. — *U. S. Dispens.* ed. 16, 1489.)

[9] A large part of the tar used in Europe is made in Scandinavia and northern Russia by burning the roots and lower parts of the trunks of *Pinus sylvestris* and *Larix Sibirica*. (See Flückiger & Hanbury, *l. c.* 560.)

[10] The bark of Larix contains from twelve to fifteen per cent. of tannic acid, and extracts of that of the European and eastern North American species are used in considerable quantities in tanning leather. The inner bark of the European Larch, chiefly in the form of a tincture, is used in medicine as a stimulating astringent and expectorant. (See Flückiger & Hanbury, *l. c.* 551. — *U. S. Dispens.* ed. 16, 870.)

[11] Briançon manna is a white saccharine substance which is found often in considerable quantities on the leaves of the European Larch

near the town of Briançon in southeastern France. Formerly it was used in medicine; but although it is still gathered by the peasants of the region, it is believed to have disappeared from trade and is no longer employed except locally. (See Flückiger & Hanbury, *Pharmacographia*, 373.) Melezitose, a peculiar sugar analogous to that of the Cane, was detected in this substance by Berthelot (*Compt. Rend.* xlvii. 224). (See, also, Bonastre, *Jour. de Pharm.* sér. 2, xix. 443, 626. — Flückiger & Hanbury, *l. c.* 373. — Bentley & Trimen, *Med. Pl.* iv. 260, t. 260.)

[12] In North America, Larix is seriously injured by several insects, but the number of species which attack these trees here and in the Old World is not large. Less than fifty species of insects are reported as living upon Larch-trees in North America, but it is probable that the number will be much increased by a more careful study of these trees in the region west of the Rocky Mountains. The trunks of living healthy Larches do not appear to be affected by borers, although several species of Scolytidæ or Bark Beetles of genera like Dendroctonus, Hylesinus, and Tomicus live under the bark of dead, dying, or weak trees. The weakness and death of these trees, which make them liable to the attacks of boring insects, is frequently caused by the ravages of foliage destroyers. The most destructive of these, which is also known in Europe, is the Larch Saw-fly, *Nematus Erichsonii*, Hartig, whose larvæ often entirely strip the trees of leaves. This pest does not appear to have been much noticed in this country before 1880, but in recent years it has attracted great attention on account of its abundance on both native and European Larches in the northeastern states and Canada; and in southern Labrador, *Larix Americana* has been almost totally destroyed by the ravages of this insect, which appears to be spreading northward and eastward. (See Low, *Rep. Geolog. Surv. Can.* n. ser. viii. 36 L.) More abundant in some years than others, it is nevertheless a constant menace to the successful growth and development of the Larch in the region where it occurs. Other species of Saw-flies which occasionally feed upon the Larch are not known to be seriously injurious.

The larvæ of a minute moth known as the Larch Sack-bearer, *Coleophora laricella*, Hübner, which has probably been introduced from Europe, have of recent years caused much injury to Larch-trees in the eastern states. The bodies of these larvæ are protected by small close-fitting cases of the same color as the bark of the twigs. The larvæ hibernate and in early spring eat out the parenchyma of the young growing leaves, leaving on the branchlets thin dry gray or whitish epidermal skeletons. In Europe, the ravages of another small moth, *Steganoptycha pinicolana*, Zeller, often cause great damage to Larch-trees, particularly on the high Swiss Alps (Christ, *Garden and Forest*, viii. 238).

The Larches of western North America are sometimes injured by the larvæ of a butterfly, *Pieris Menapia*, Felder, and the larvæ of various moths of several families are found upon Larches, but rarely in sufficient numbers to cause permanent injury.

Among Aphids, *Lachnus laricifex*, Fitch, and *Chermes laricifoliæ*, Fitch, are sometimes more or less abundant on the twigs and leaves; and Larch-trees cultivated in the eastern states are occasionally seriously affected by red mites, *Tetranychus telarius*, Linnæus.

[13] The most serious disease of the Larch is a fungus, which attacks the European species and is known as Canker or Krebs, caused by *Dasyscypha Willkommii*, R. Hartig (*Untersuch. Forst. Bot. Institut, München*, i. 63). The mature condition of this fungus, consisting of small waxy cups, which are fringed on the outer surface and margins with minute whitish hairs, while the disk is yellowish red, is found in depressions on the surface of the stems and young branches. It does not appear to be able to make its way into the tree unless the surface of the branches has been injured by hail or the attacks of insects. It is said to occur also in the United States, but its range here is not well known, as *Dasyscypha Willkommii* of earlier authors has not always been distinguished from *Dasyscypha calycina* or from *Dasyscypha Agassizii*, Berkeley & Curtis. The leaves of the European Larch are attacked by the rust, *Cæoma Laricis*, Westendorp, which forms golden yellow cushion-like spots on their under surface. This fungus is believed by mycologists to be connected genetically with *Melampsora Tremulæ*, Tulasne, which forms insignificant spots on the leaves of *Populus tremula* in Europe and occurs also on species of Populus in the United States.

A serious disease of the Larch in Germany, which causes the leaves to fall in large quantities, is attributed by Hartig to the attacks of *Sphærella laricina*, R. Hartig, and the discoloration and death of Larch leaves are caused by *Hypodermella Laricis*, Tubeuf.

In general, the diseases of *Larix Americana* do not appear to be important, or at least they have not attracted the attention of mycologists to any extent. Species of Polyporus and Trametes, which injure the trunks of the Tamarack, are not, however, peculiar to the Larch. (See P. M. Dudley, *Bull.* No. 1, *Div. Forestry U. S. Dept. Agric.* Appx. 1, 52.) *Polyporus officinalis*, Fries, formerly used in medicine, forms white irregular masses on the Larch in Europe, especially in Russia.

The diseases of the western American species of Larix have not been studied.

[14] *Inst.* 586, t. 357.

CONSPECTUS OF THE NORTH AMERICAN SPECIES.

Cones small, subglobose; their scales few, longer than the bracts.
  Leaves triangular . . . . 1. L. AMERICANA.
Cones elongated; their scales numerous, shorter than the bracts.
  Young branchlets pubescent, soon becoming glabrous; leaves triangular . . . . 2. L. OCCIDENTALIS.
  Young branchlets tomentose; leaves tetragonal . . . . 3. L. LYALLII.

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LARIX AMERICANA.

Tamarack. Larch.

CONES small, subglobose, the scales few, longer than their bracts.

Larix Americana, Michaux, *Fl. Bor.-Am.* ii. 203 (1803). — Michaux f. *Hist. Arb. Am.* iii. 37, t. 4. — Audubon, *Birds*, t. 4. — Emerson, *Trees Mass.* 89; ed. 2, i. 105, t. — Gihoul, *Arb. Rés.* 51. — (Nelson) Senilis, *Pinaceæ*, 86. — Hoopes, *Evergreens*, 247. — Nördlinger, *Forstbot.* 427, f. — Regel, *Gartenflora*, xx. 105, t. 684, f. 7, 8; *Act. Hort. Petrop.* i. 160; *Belge Hort.* xxii. 105, t. 10, f. 2, 3. — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 90. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 215. — Watson & Coulter, *Gray's Man.* ed. 6, 493. — Mayr, *Wald. Nordam.* 221. — Beissner, *Handb. Nadelh.* 329, f. 92. — Hansen, *Jour. R. Hort. Soc.* xiv. 413 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 28.

Pinus Larix Americana nigra, Muenchhausen, *Hausv.* v. 226 (1770).

Pinus laricina, Du Roi, *Obs. Bot.* 49 (1771); *Harbk. Baumz.* ii. 83, t. 3, f. 5–7. — Burgsdorf, *Anleit.* pt. ii. 165. — Wangenheim, *Nordam. Holz.* 42, t. 16, f. 37. — Schoepf, *Mat. Med. Amer.* 142. — Moench, *Meth.* 364. — Borkhausen, *Handb. Forstbot.* i. 451.

Pinus Larix Canadensis, Wangenheim, *Beschreib. Nordam. Holz.* 43 (1781).

Pinus Larix rubra, Marshall, *Arbust. Am.* 103 (1785). — Schoepf, *Mat. Med. Amer.* 142.

Pinus Larix alba, Marshall, *Arbust. Am.* 104 (1785).

Pinus Larix nigra, Marshall, *Arbust. Am.* 104 (1785).

Pinus pendula, Aiton, *Hort. Kew.* iii. 369 (1789). — Willdenow, *Berl. Baumz.* 215; *Spec.* iv. pt. i. 502. — Lambert, *Pinus*, i. 56, t. 36. — Persoon, *Syn.* ii. 579. — Pursh, *Fl. Am. Sept.* ii. 645. — Nuttall, *Gen.* ii. 223. — Sprengel, *Syst.* iii. 887. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 27. — Audubon, *Birds*, t. 90, 180. — Hooker, *Fl. Bor.-Am.* ii. 164. — Torrey, *Fl. N. Y.* ii. 232. — Endlicher, *Syn. Conif.* 132. — Lawson & Son, *List No. 10, Abietineæ*, 21. — Dietrich, *Syn.* v. 395. — Courtin, *Fam. Conif.* 66. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 409.

Pinus Larix, β rubra, Castiglioni, *Viag. negli Stati Uniti*, ii. 315 (1790).

Pinus Larix, γ nigra, Castiglioni, *Viag. negli Stati Uniti*, ii. 315 (1790).

Pinus Larix, δ alba, Castiglioni, *Viag negli Stati Uniti*, ii. 315 (1790).

Pinus intermedia, Du Roi, *Harbk. Baumz.* ed. 2, ii. 114 (1800).

Pinus microcarpa, Lambert, *Pinus*, i. 58, t. 37 (1803). — Willdenow, *Spec.* iv. pt. i. 502; *Enum.* 989; *Berl. Baumz.* ed. 2, 273. — Persoon *Syn.* ii. 579. — Stokes, *Bot. Mat. Med.* iv. 435. — Aiton, *Hort. Kew.* ed. 2, v. 321. — Bigelow, *Fl. Boston.* 235. — Pursh, *Fl. Am. Sept.* ii. 645. — Nuttall, *Gen.* ii. 223. — Hayne, *Dendr. Fl.* 175. — Sprengel, *Syst.* iii. 887. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 27. — Meyer, *Pl. Labrador.* 30. — Hooker, *Fl. Bor.-Am.* ii. 164. — Antoine, *Conif.* 54, t. 21, f. 1. — Endlicher, *Syn. Conif.* 132. — Lawson & Son, *List No. 10, Abietineæ*, 21. — Dietrich, *Syn.* v. 395. — Courtin, *Fam. Conif.* 66.

Abies pendula, Poiret, *Lamarck Dict.* vi. 514 (1804). — *Nouveau Duhamel*, v. 288. — Lindley, *Penny Cycl.* i. 33. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 213.

Abies microcarpa, Poiret, *Lamarck Dict.* vi. 514 (1804). — *Nouveau Duhamel*, v. 289, t. 79, f. 2. — Lindley, *Penny Cycl.* i. 33. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 213.

Larix pendula, Du Mont de Courset, *Bot. Cult.* iii. 771 (1802). — Salisbury, *Trans. Linn. Soc.* viii. 314. — Lawson & Son, *Agric. Man.* 387. — Forbes, *Pinetum Woburn.* 137, t. 46. — Carrière, *Traité Conif.* 279. — Gordon, *Pinetum*, 129. — Courtin, *Fam. Conif.* 66. — Sénéclauze, *Conif.* 105. — Schübeler, *Virid. Norveg.* i. 441. — Willkomm, *Forst. Fl.* ed. 2, 156. — Masters, *Jour. R. Hort. Soc.* xiv. 218.

Larix tenuifolia, Salisbury, *Trans. Linn. Soc.* viii. 314 (1807).

Larix microcarpa, Desfontaines, *Hist. Arb.* ii. 597 (1809). — Lawson & Son, *Agric. Man.* 388. — Forbes, *Pinetum Woburn.* 139, t. 47. — Spach, *Hist. Vég.* xi. 436. — Link, *Linnæa*, xv. 536. — Carrière, *Traité Conif.* 275. — Gordon, *Pinetum*, 129. — Henkel & Hochstetter, *Syn. Nadelh.* 137. — Sénéclauze, *Conif.* 105. — Regel, *Russ. Dendr.* pt. i. 29. — Veitch, *Man. Conif.* 130. — Lauche, *Deutsche Dendr.* ed. 2, 100. — Schübeler, *Virid. Norveg.* i. 441. — Willkomm, *Forst. Fl.* ed. 2, 157.

Larix intermedia, Lawson & Son, *Agric. Man.* 389 (1836). — Forbes, *Pinetum Woburn.* 141. — Link, *Linnæa*, xv. 535.

Larix Americana rubra, Loudon, *Arb. Brit.* iv. 2400 (1838). — Knight, *Syn. Conif.* 40.

Larix Americana pendula, Loudon, *Arb. Brit.* iv. 2400 (1838). — Carrière, *Traité Conif.* ed. 2, 356. — Sénéclauze, *Conif.* 101.

Larix Americana prolifera, Loudon, *Arb. Brit.* iv. 2401 (1838). — Carrière, *Traité Conif.* ed. 2, 356.

Larix decidua, γ Americana, Henkel & Hochstetter, *Syn. Nadelh.* 133 (1865).

Larix laricina, K. Koch, *Dendr.* ii. pt. ii. 263 (1873). —

Lauche, *Deutsche Dendr.* ed. 2, 99. — Sudworth, *Rep. U. S. Dept. Agric.* 1892, 330. — Britton & Brown, *Ill. Flor.* i. 54, f. 120.

Larix laricina, var. **microcarpa**, Lemmon, *Rep. California State Board Forestry*, iii. 108 (*Cone-Bearers of California*) (1890).

Larix laricina, var. **pendula**, Lemmon, *Rep. California State Board Forestry*, iii. 108 (*Cone-Bearers of California*) (1890).

A tree, from fifty to sixty feet in height, with a trunk eighteen or twenty inches in diameter, but often much smaller toward the northern and southern limits of its range. During its early years the slender horizontal branches form a narrow regular pyramidal head, which continues to characterize this tree when it is crowded by its associates in the forest; but where it can obtain abundant light and air some of the specialized upper branches grow more vigorously than the others and than those below them and sweep out in graceful curves, or often become much contorted and frequently pendulous and form a broad open head which is sometimes extremely picturesque. The bark of the trunk is from one half to three quarters of an inch in thickness, and separates into thin closely appressed rather bright reddish brown scales. The slender leading branchlets are glabrous in their first summer and are often covered with a glaucous bloom; during the following winter they are light orange-brown and conspicuous from the small globose dark red lustrous buds; during their second season they gradually grow darker, and in the third and fourth years become dark brown and dingy and begin to lose the spur-like lateral branchlets. The leaves are triangular, rounded above, prominently keeled on the lower surface, from three quarters of an inch to an inch and a quarter in length and about one thirty-second of an inch in width; they are bright green and conspicuously stomatiferous when they first expand, which is from the beginning to the end of May, according as the tree grows at the south or at the north, and, gradually becoming darker during the summer, they turn dull yellow in September or October not long before they fall. The staminate flowers are subglobose and sessile, with pale yellow anthers, and are principally borne on branchlets one or two years old. The pistillate flowers are oblong and short-stalked, with light rose-colored bracts produced into elongated green tips and nearly orbicular rose-red scales, and usually appear on branchlets from one to three years old. The cones when they are fully grown and begin to open in the autumn are raised on stout incurved stems, and are oblong, rather obtuse, and from one half to three quarters of an inch in length, and are composed of about twenty scales; these are largest near the middle of the cone, diminishing toward its extremities, and are very concave, slightly erose or nearly entire on the margins, semiorbicular but usually rather longer than broad, and about twice as long as their bracts, which are emarginate and furnished at the apex with short mucros; as the cone enlarges the scales gradually lose their red color, and when fully grown are light bright chestnut-brown; growing darker after their first winter, during which they gradually scatter their seeds, they usually fall during their second year, although occasionally a few cones remain on the branches through another season. The seeds are an eighth of an inch in length, with a pale coat, and are about one third as long as the light chestnut-brown wings, which are broadest near the middle and obliquely rounded at the apex.

From about latitude 58° north, near the coast of Labrador, *Larix Americana* ranges northwestward nearly to the southern shore of Ungava Bay; the line which marks the northern limits of its range then extends westward, and, turning toward the south, reaches the shore of Hudson Bay a few miles south of the mouth of the Nastapoka River,[1] and from a point a little to the northwest of Port Churchill on the western shore of Hudson Bay, in latitude 59° north, extends northwestward to the northern shores of Great Bear Lake, from which the Larch follows down the valley of the Mackenzie River nearly to latitude 67° 30′ north.[2] West of the Rocky Mountains *Larix Americana* ranges westward

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[1] The distribution of *Larix Americana* east of Hudson Bay as here laid down is partly taken from Dr. Robert Bell's paper on the geographical distribution of forest trees in Canada, first published in the *Scottish Geographical Magazine*, xiii. 283.

[2] Richardson, *Franklin Jour.* Appx. No. 7, 752 (as *Pinus microcarpa*); *Arctic Searching Exped.* ii. 318.

On Peel River Portage, a divide between the waters of the Mackenzie and Yukon Rivers, in latitude 67° 30′ north, *Larix* along the Dease River and along the upper Liard and Frances Rivers, and northward nearly to Finlayson Lake, reaching 65° 35′ north.[1] Southward it spreads through Canada[2] and the northern states to northern Pennsylvania,[3] northern Indiana and Illinois and central Minnesota, and to about latitude 53° north in Alberta on the eastern foothills of the Rocky Mountains.[4] Of the trees of the subarctic forest of America, *Larix Americana* best supports the rigors of the boreal climate, and at the extreme northern limits of the forest is still a little tree rising above its associate, the Black Spruce, which clings to the ground with nearly prostrate stems. In the interior of Labrador,[5] where it is the largest tree, it is surpassed in numbers only by the Black Spruce, and grows in all the cold swamps, and in the southern part of the peninsula occurs occasionally on well-drained benches a few feet above the surface of rivers.[6] It grows near the western shore of Hudson Bay with the White Spruce as far north as the mouth of Little Seal River, and northwest up to the very margin of the barren lands, the great rolling grass-covered plains which stretch beyond the subarctic forest to the shores of the Arctic Sea, extending down the Telzoa River as far north as Doobaunt Lake and down the Kazan nearly to Yathkyed Lake, where it attains a larger size than its companion, the Black Spruce.[7] West of the Rocky Mountains, where it is usually associated with the Black Spruce, it is abundant in cool swamps and on northern slopes; it is common in swamps in Saskatchewan, through which it crosses from the eastern base of the Rocky Mountains to Manitoba, where it finds the southwestern limit of its range near Carberry, southwest of Lake Manitoba,[8] and probably attains its largest size north of Lake Winnipeg on low benches which it occasionally covers with open forests. In the maritime provinces of Canada and in the United States it inhabits cold deep swamps, which it often clothes with forests of closely crowded trees rarely more than forty or fifty feet in height.

The wood of *Larix Americana* is heavy, hard, very strong, rather coarse-grained, compact, and very durable in contact with the soil; it is light brown, with thin nearly white sapwood, and contains broad very resinous dark-colored bands of summer cells, few obscure resin passages, and numerous hardly distinguishable medullary rays. The specific gravity of the absolutely dry wood is 0.6236, a cubic foot weighing 38.86 pounds. It is largely used for the upper knees of vessels, for ship timbers, fence-posts, telegraph-poles, and railway-ties.

Although *Larix Americana* is said to have been cultivated by Philip Miller, in the Physic Garden at Chelsea, as early as 1735,[9] the first account of it appeared in Charlevoix's *Histoire de la Nouvelle France*, published in 1744.[10] It was known, however, much earlier to the European settlers in New England, as Josselyn described its merits soon after the middle of the seventeenth century.[11]

Americana, which here grows to a height of six or eight feet, with a trunk an inch in diameter, extends in small open groves above the Spruces and up to elevations of twelve hundred feet above the level of the sea. (See McConnell, *Rep. Geolog. Surv. Can.* n. ser. iv. 117 D.)

[1] G. M. Dawson, *Garden and Forest*, i. 58; *Rep. Geolog. Surv. Can.* n. ser. iii. pt. i. 112 B; Appx. i. 187 B. — Macoun, *Rep. Geolog. Surv. Can.* n. ser. iii. pt. i. Appx. iii. 226 B.

Larix Americana was not found by Dr. G. M. Dawson on the Pelley and Lewes Rivers, but he suggests that the Larch seen by Dall (*Alaska and its Resources*, 441, 592) on the lower Yukon is probably this species, which he thinks may be found to extend from the valley of the Mackenzie nearly to the shores of Behring Sea.

[2] Provancher, *Flore Canadienne*, ii. 558. — Brunet, *Cat. Vég. Lig. Can.* 59. — Macoun, *Cat. Can. Pl.* 475.

[3] Rothrock, *Rep. Dept. Agric. Penn.* 1895, pt. ii. *Div. Forestry*, 284.

In Pennsylvania *Larix Americana* grows sparingly in the coldest parts of Pike, Monroe, Luzerne, and Lackawanna counties, or on the Pocano Plateau and the adjacent regions. It grows in Tamarack Swamp in the northern part of Clinton County, and it is said, on doubtful authority, to occur in Somerset County on the high Alleghanies up to elevations of three thousand feet above the sea.

[4] The most southern station in Alberta where *Larix Americana* has been seen by Mr. John Macoun is in a swamp forty miles southwest of Edmonton.

[5] On the Labrador coast trees grow in protected valleys at the heads of the inner bays up to latitude 58° north, although the western foothills of the Atlantic coast range are treeless. Two degrees farther south they grow on the coast and high up on the hills; the headlands and outer hills remain, however, treeless as far south as Hamilton Inlet. (See Low, *Rep. Geolog. Surv. Can.* n. ser. viii. 31 L.)

[6] Low, *l. c.* 36.

[7] Tyrrell, *Rep. Geolog. Surv. Can.* n. ser. ix. 214 F.

[8] *Teste* John Macoun.

[9] Aiton, *Hort. Kew.* iii. 369 (*Pinus pendula*). — Loudon, *Arb. Brit.* iv. 2399.

[10] *Larix Canadensis, longissimo folio*, ed. 12mo, iv. 371, f. 92.

[11] "Groundsels made of Larch-tree will never rot, and the

Usually an inhabitant of lands saturated with water, *Larix Americana*, when transplanted to uplands, grows in good soil much more rapidly than it does in its native swamps, attaining a larger size and more picturesque habit, and of all the Larch-trees which have been tried in the northern states it best deserves attention as an ornament of parks and gardens.

longer it lyes the harder it growes, that you may almos nail into a bar of Iron as easily as into that." (Josselyn, *An Account of Two Voyages to New England*, 68.)

"The turpentine that issueth from the cones of the Larch-tree (which comes nearest of any to the right Turpentine) is singularly good to heal wounds, and to draw out the malice (or Thorn, as *Helmont* phrases it) of any Ach rubbing the place therewith, and strowing upon it the powder of *Sage*-leaves." (*Ibid.* p. 67.)

"I cured once a desperate Bruise with a Cut upon the Knee Pan, with an Ungent made with the Leaves of the *Larch Tree*, and Hogs Grease, but the Gum is best." (Josselyn, *New England Rarities*, 63.)

EXPLANATION OF THE PLATE.

PLATE DXCIII. LARIX AMERICANA.

1. A flowering branch, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. A pistillate flower, enlarged.
6. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. Vertical section of a seed, enlarged.
11. An embryo, enlarged.
12. Cross section of a leaf, magnified fifteen diameters.
13. A winter branchlet, natural size.
14. A seedling plant, natural size.

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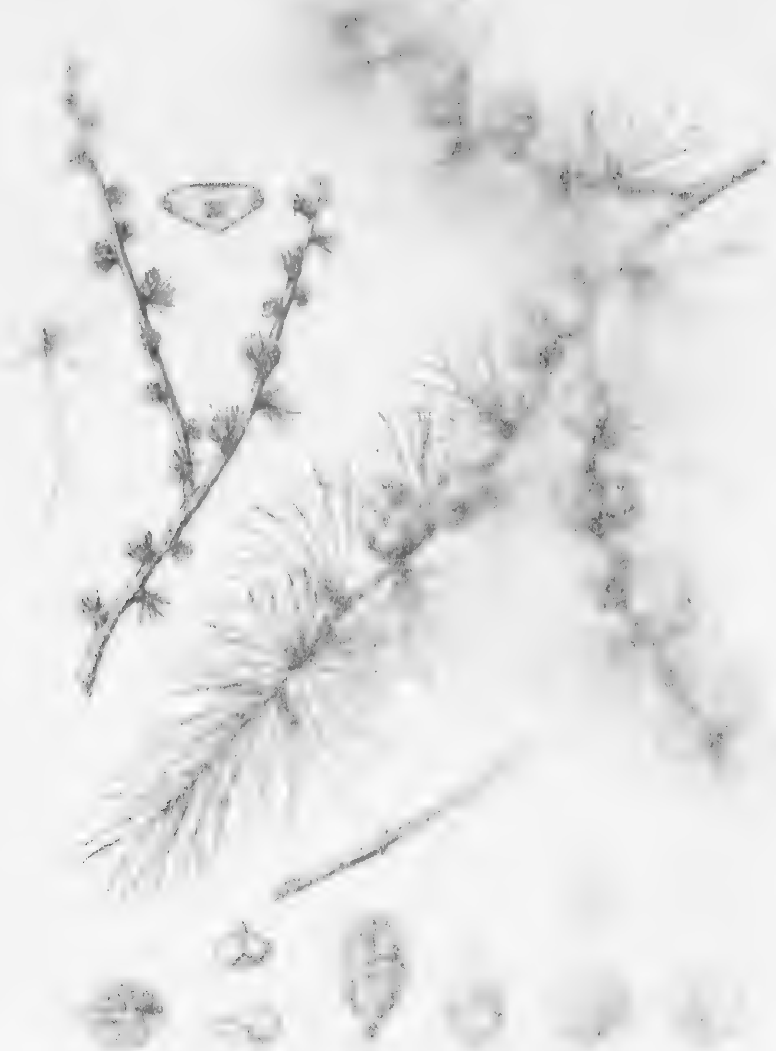
id. p. 67.)
upon the Knee
Larch Tree, and
, *New England*



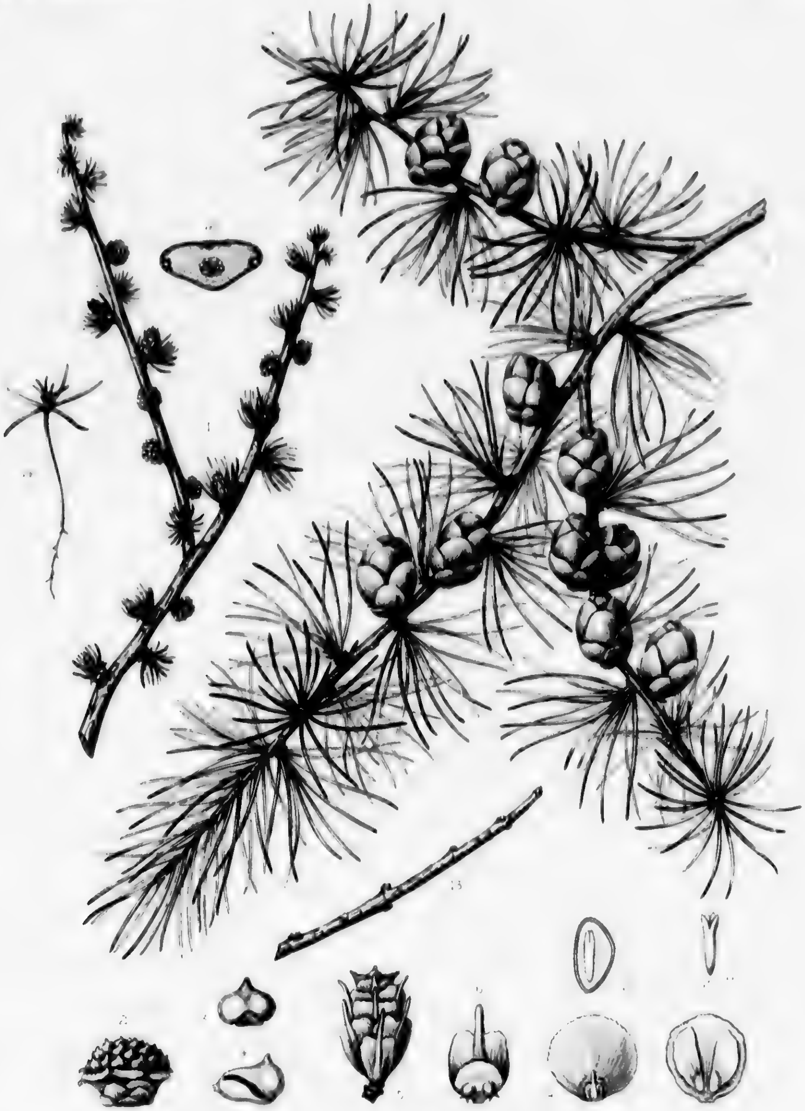
[illegible] *Americana*. When transplanted to [illegible] rapidly than it does in its native swamps, attaining a larger size [illegible] Larches which have been tried in the northern states it [illegible] of parks and gardens.

[illegible] Ash [illegible] powder [illegible] Cut upon the bone [illegible] the Leaves of the *Larch Tree* [illegible] best." (Josselyn, *New England* [illegible])

[illegible]

[illegible] enlarged.

- [illegible] natural size.
- [illegible] natural size.
- [illegible] with its seeds, natural size.
- 10. [illegible] of a seed, enlarged.
- 11. [illegible] enlarged.
- 12. Cross-section of a leaf, [illegible] fifteen diameters.
- 13. [illegible]
- 14. [illegible]



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LARIX OCCIDENTALIS.

Tamarack.

Cones elongated, the scales numerous, shorter than their bracts. Young branchlets soon becoming glabrous. Leaves triangular.

Larix occidentalis, Nuttall, *Sylva*, iii. 143, t. 120 (1849). — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 59, f. 24, 25. — Cooper, *Am. Nat.* iii. 412. — Lyall, *Jour. Linn. Soc.* vii. 143. — (Nelson) Senilis, *Pinaceæ*, 91. — Hoopes, *Evergreens*, 253. — Regel, *Gartenflora*, xx. 103, t. 685, f. 8–10; *Act. Hort. Petrop.* i. 158; *Belge Hort.* xxii. 101, t. 8, f. 3–5. — Gordon, *Pinetum*, ed. 2, 176. — Veitch, *Man. Conif.* 130. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 216; *Gard. Chron.* n. ser. xxv. 652, f. 145; *Garden and Forest*, ix. 491, f. 71. — Mayr, *Wald. Nordam.* 347. — Lemmon, *Rep. California State Board Forestry*, iii. 108 (*Cone-Bearers of California*). — Beissner, *Handb. Nadelh.* 314, f. 80. — Masters, *Jour. R. Hort. Soc.* xiv. 218. — Hansen, *Jour. R. Hort. Soc.* xiv. 417 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 25. — Leiberg, *Contrib. U. S. Nat. Herb.* v. 50.

Pinus Nuttallii, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 412 (1868).

When it has grown under the most favorable conditions on low moist soil, at elevations of between two thousand and three thousand feet above the sea-level, the western Larch often rises to the height of two hundred and fifty feet, with a trunk from six to eight feet in diameter; on drier soil and exposed mountain slopes it has an average height of about one hundred feet, with a trunk two or three feet in diameter. On young trees the remote elongated and nearly horizontal branches form an open pyramidal head; usually they soon disappear from the lower part of the stem, and the full-grown tree is remarkable for its elongated tapering naked trunk, which is frequently free of branches for two hundred feet above the ground and is surmounted by a short narrow pyramidal head of small branches clothed with scanty foliage,[1] or occasionally at low altitudes the crown is larger, with elongated drooping branches. The bark of young stems is thin, dark-colored, and scaly, but when the tree is about one hundred years old the bark changes in character, and, beginning near the base, where on old trunks it is often five or six inches thick, it breaks into irregularly shaped oblong plates frequently two feet in length and covered with thin closely appressed light cinnamon-red scales. The leading branchlets are comparatively stout, and when they first appear are covered with soft pale pubescence, which on some trees disappears during the first season and on others continues to cover the shoots until their second year; they are bright orange-brown in their first year and sometimes retain this color during a second season, although they more often then begin to assume the dark gray-brown color of the older branches and of the lateral branchlets, which, usually short, are occasionally nearly three quarters of an inch in length. The winter-buds are globose and about an eighth of an inch in diameter, their dark chestnut-brown scales being erose and often coated on the margins with hoary tomentum. The leaves are triangular, rounded on the back, conspicuously keeled on the lower surface, rigid, sharp-pointed, from an inch to an inch and three quarters in length, about one thirty-second of an inch in width, and light pale green, turning pale yellow early in the autumn. The staminate flowers are oblong, with pale yellow anthers, and at maturity are raised on stout stalks about an eighth of an inch long. The pistillate flowers are oblong, almost sessile, with nearly orbicular scales, and with bracts which are produced into elongated tips. The cones are oblong, short-stalked, and from an inch to an inch and a half in length, with numerous thin stiff scales which are nearly entire or slightly erose and sometimes a little reflexed on the margins; they are more or less thickly coated on the lower surface below the middle with hoary tomentum, and after the seeds are scattered stand out at right angles to the axis of the cone or often become reflexed. The seeds are nearly a quarter of an inch long, with a pale brown coat, and are from one half to two thirds the length of the thin and fragile pale wings, which are broadest near the middle and obliquely rounded at the apex.

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[1] The most remarkable fact, perhaps, about this tree is the smallness of leaf surface in comparison with height and thickness of stem, and there is certainly no other instance among the trees of the northern hemisphere where such massive trunks support such small short branches and sparse foliage. It is not, therefore, surprising that *Larix occidentalis* grows slowly after the loss of its lower branches, usually at the end of forty or fifty years. The specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is eighteen inches in diameter inside the bark and two hundred and sixty-seven years old. At the age of fifty years the trunk of this tree was nine inches in diameter; the sapwood, which is half an inch thick, contains forty layers of annual growth.

Scattered on the moist deep soil of bottom-lands through forests of Hemlocks, Firs, and Cottonwoods, and mixed with the Yellow Pine, the Lodge Pole Pine, and the Douglas Spruce on high benches and dry mountain sides, the western Larch grows at elevations of between two thousand and seven thousand feet above the sea-level, usually singly or in small groves. Its home is in the basin of the upper Columbia River, from which it crosses in southern British Columbia to the mountains overlooking the eastern shores of Shuswap Lake, one of the sources of the south fork of the Thompson, where it finds the northern limits of its range in latitude 51° north, and is not abundant;[1] in the United States it grows near most of the mountain streams which feed the Columbia, from the western slopes of the continental divide in northern Montana to the eastern slopes of the Cascade Mountains, extending southward to the Blue and Powder River Mountains and the eastern foothills of Mt. Jefferson in Oregon. Of comparatively small size and less generally multiplied northward and southward and on the Cascade Mountains, the western Larch is most abundant and attains its largest size on the bottom-lands of the streams which flow into Flat Head Lake in northern Montana, and in northern Idaho, where it is the characteristic and most interesting inhabitant of the great forests that cover this interior region.

The noblest of the Larch-trees, surpassing all others in thickness and height of stem, splendid in massiveness and in the colors of the great plates into which its bark is divided, *Larix occidentalis* is one of the most valuable timber-trees of the continent, and no other North American coniferous tree produces such hard and heavy wood, well suited for use in furniture of the best quality. The wood is very heavy, exceedingly hard and strong, close-grained, susceptible of receiving a good polish, and very durable in contact with the soil; it is bright light red, with thin nearly white sapwood, and contains broad dark-colored resinous bands of small summer cells, few obscure resin passages, and numerous thin medullary rays; the specific gravity of the absolutely dry wood is 0.7407, a cubic foot weighing 46.16 pounds. It is largely used for railway-ties and fence-posts, and is manufactured into lumber used in cabinet-making and the interior finish of buildings. An exudation, which flows abundantly from wounds in the trunk and forms large sheets, has a sweetish taste, and is gathered and eaten by Indians in southern British Columbia.[2]

The earliest notice of *Larix occidentalis* is in the journal of Lewis and Clark, who, in their entry of June 15, 1806, record the occurrence of a Larch-tree in the forests on the upper Clearwater River, which they ascended in crossing the Bitter Root Mountains on their homeward journey.[3] In 1827 it was seen near Fort Colville on the upper Columbia by David Douglas, who mistook it for the Larch of Europe,[4] but to Thomas Nuttall, who found it on the Blue Mountains in 1834, belongs the credit of

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[1] G. M. Dawson, *Can. Nat.* n. ser. ix. 329. — Macoun, *Cat. Can. Pl.* 475.

[2] This substance, which is of a brownish yellow color, somewhat porous, and possesses a moderately sweet taste with a terebinthine flavor, is found by Trimble to be free from resin and not identical with melezitose, as might have been expected, its physical properties closely resembling dextrin. (See *Am. Jour. Pharm.* lxx. 152.)

[3] *History of the Expedition under Command of Lewis and Clark*, ed. Coues, iii. 1043, 1066. — Sargent, *Garden and Forest*, x. 39.

[4] Douglas, *Companion Bot. Mag.* ii. 109.

Of this tree Douglas, in his journal, says: "I measured some thirty feet in circumference; and several which have been leveled to the ground by the late storms were one hundred and forty-five feet long, with wood perfectly clean and strong." If Douglas had realised that he was in the presence of one of the great trees of first distinguishing this tree. *Larix occidentalis* was first cultivated in 1881 in the Arnold Arboretum, where it is hardy and produces cones.[1]

In the struggle for supremacy between the different inhabitants of the Columbian forests under the changed conditions which have followed the white man's occupation of the country, *Larix occidentalis* seems destined to hold its own and probably even to extend its sway, for in this struggle, in which fire now plays a controlling part, it is aided by the great thickness of its bark, which enables half-grown trees to bear without permanent injury the heat of annual fires, and by the power of its abundant seeds to germinate and of its seedlings to grow rapidly in the shade of other trees and in favorable situations often to overtop and finally to destroy them.

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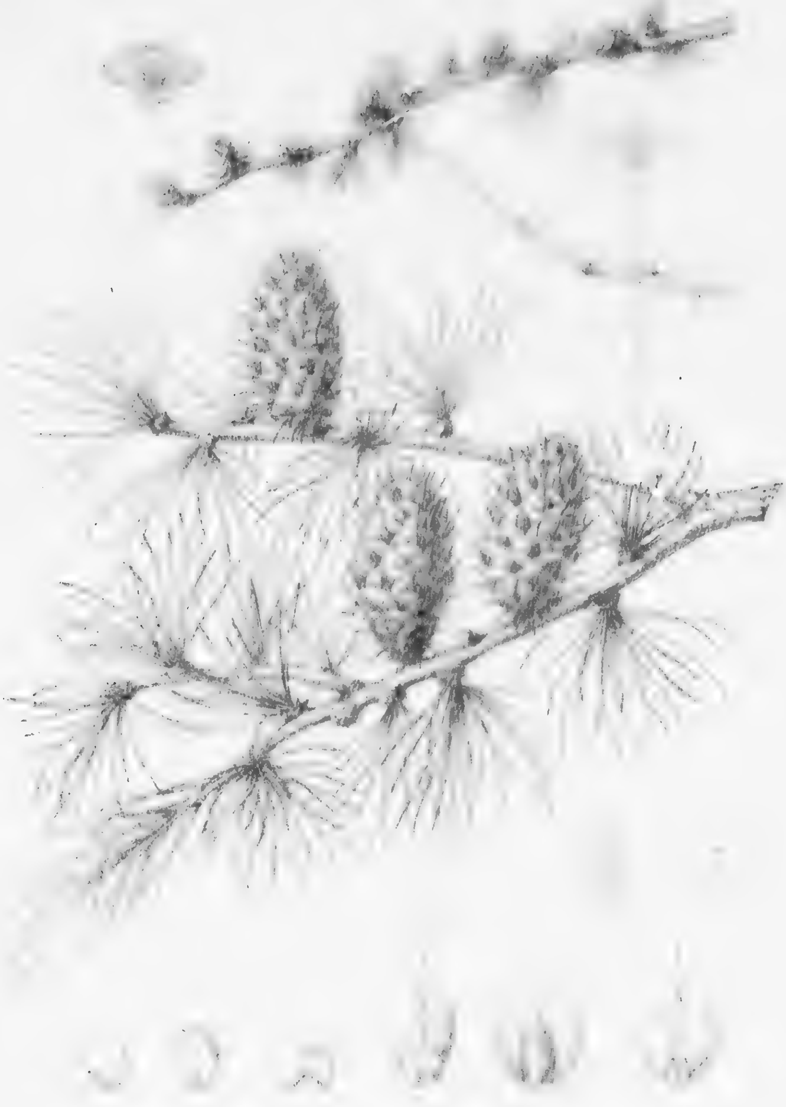
the world, as remarkable as the Sugar Pine or any of his other discoveries, the western Larch would not probably have remained one of the least known of the important timber-trees of America.

[1] Seedling plants of *Larix occidentalis*, transferred from Oregon to the Arnold Arboretum in 1881, have remained small and stunted, but branches of these trees grafted on roots of the Japanese Larch have grown vigorously into shapely trees now nearly twenty feet in height and almost twice as large as the seedlings.

EXPLANATION OF THE PLATE.

Plate DXCIV. Larix occidentalis.

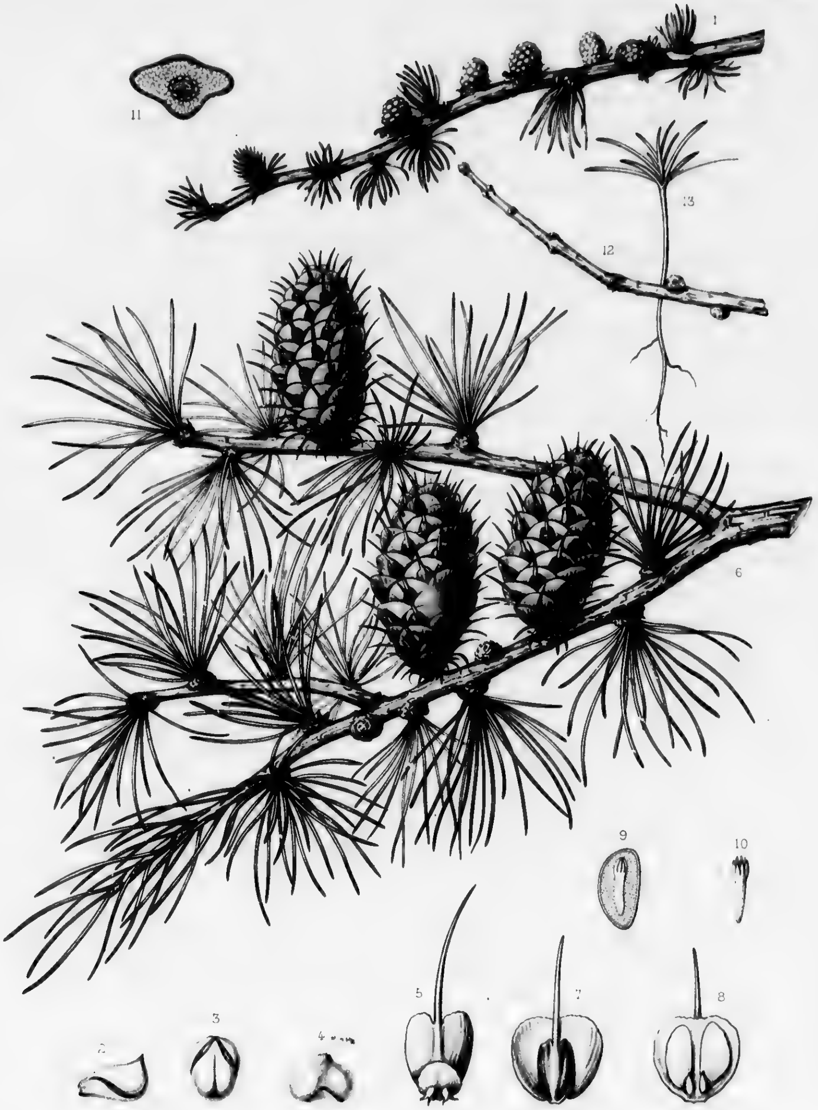
1. A flowering branch, natural size.
2. An anther, side view, enlarged.
3. An anther, rear view, enlarged.
4. An anther, front view, enlarged.
5. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
6. A fruiting branch, natural size.
7. A cone-scale, lower side, with its bract, natural size.
8. A cone-scale, upper side, with its seeds, natural size.
9. Vertical section of a seed, enlarged.
10. An embryo, enlarged.
11. Cross section of a leaf, magnified fifteen diameters.
12. A winter branchlet, natural size.
13. A seedling plant, natural size.



EXPLANATION [illegible]

[illegible]

1. A [illegible]
2. An [illegible], enlarged.
3. An [illegible], enlarged.
4. An [illegible] view, enlarged.
5. A scale of a pistillate flower, upper side, with [illegible], enlarged.
6. A fruiting branch, natural size.
7. A cone-scale, lower side, with [illegible]
8. A cone-scale, upper side, with its seeds, natural size.
9. Vertical section of a seed, enlarged.
10. An embryo, enlarged.
11. Cross section of a leaf, magnified fifteen diameters.
12. A winter branchlet, natural size.
13. A seedling plant, natural size.



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LARIX LYALLII.

Tamarack.

Cones elongated, their scales shorter than the bracts. Branchlets tomentose. Leaves tetragonal.

Larix Lyallii, Parlatore, *Enum. Sem. Hort. Reg. Mus. Flor.* 1863; *Jour. Bot.* i. 35; *Gard. Chron.* 1863, 916; *Gartenflora*, xiii. 244. — Lyall, *Jour. Linn. Soc.* vii. 143. — Henkel & Hochstetter, *Syn. Nadelh.* 417. — Carrière, *Traité Conif.* ed. 2, 361. — Hoopes, *Evergreens*, 256. — Regel, *Gartenflora*, xx. 103, t. 685, f. 11–13; *Act. Hort. Petrop.* i. 158; *Belge Hort.* xxii. 102, t. 9, f. 1–3. — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 90. — Veitch, *Man. Conif.* 130. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 216; *Gard. Chron.* n. ser. xxv. 653, f. 146; ser. 3, xxiii. 356, f. 136. — Mayr, *Wald. Nordam.* 355. — Lemmon, *Rep. California State Board Forestry*, iii. 109 (*Cone-Bearers of California*). — Beissner, *Handb. Nadelh.* 316, f. 81. — Masters, *Jour. R. Hort. Soc.* xiv. 218.

Pinus Lyallii, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 412 (1868).

A tree, usually from forty to fifty and occasionally seventy-five feet in height, with a trunk generally eighteen or twenty inches but sometimes three or four feet in diameter, and remote elongated palmately divided exceedingly tough persistent branches which, developing very irregularly, are sometimes decidedly pendulous and sometimes abruptly ascending at the extremities, one or two being frequently much longer and stouter than the others, and sometimes twenty feet in length. Until the tree is about fifteen feet high the bark of the slender stem and branches is thin, rather lustrous, smooth and pale gray tinged with yellow; it is dark brown and broken into loose thin scales on larger stems and on the large branches of old trees, and on fully grown trunks it becomes from one half to three quarters of an inch in thickness, and is slightly divided by shallow fissures into irregularly shaped plates which are covered with thin dark red-brown loosely attached scales. The winter-buds are prominent, and conspicuous from the long white matted hairs which fringe the margins of their scales, and, protruding from between them, often almost entirely cover the bud. The leading branchlets are stout and coated with thick hoary tomentum, which does not entirely disappear until after their second winter; they then begin gradually to grow darker, and sometimes become nearly black at the end of four or five years, when their stout lateral spur-like branchlets have occasionally attained the length of three quarters of an inch. The leaves are tetragonal, rigid, short-pointed, pale blue-green and from an inch to an inch and a half in length. The staminate flowers are oblong and about an eighth of an inch long, with pale yellow anthers, and are raised on short stout stalks. The pistillate flowers are ovate-oblong, with dark red or occasionally pale yellow-green scales and dark purple bracts which are abruptly contracted into elongated slender tips. The cones are ovate, rather acute, and from an inch and a half to nearly two inches in length, and are subsessile or raised on slender peduncles coated with hoary tomentum; their bracts are dark purple, exserted and very conspicuous, with slender tips much longer than the oblong-obovate thin dark reddish purple or rarely green scales; these are erose and their margins are fringed with matted white hairs, which are also scattered over their lower surface, being thickest near the middle; at maturity the scales spread nearly at right angles from the stout axis of the cone, which is densely covered with pale tomentum, and frequently become much reflexed before the falling of the cone, which usually occurs during the first autumn. The seeds are full and rounded on the sides, an eighth of an inch in length and about half as long as their light red lustrous wings, which are broadest near the base, with nearly parallel sides.

Larix Lyallii, which grows only near the timber-line on mountain slopes between four thousand five hundred and eight thousand feet above the level of the sea, is distributed from southern Alberta and the interior of southern British Columbia[1] southward along the Cascade Mountains and through northern Washington to Mt. Stewart, one of their eastern spurs at the head of a north fork of the Yakima River.[2] In Alberta *Larix Lyallii* grows on steep mountain slopes and benches, usually on those which face the north, either singly or in groves of a few hundred trees, and alone or mixed with the Engelmann Spruce; on the elevated plateau which extends from northern Washington into British Columbia, about the State Creek Pass through the Cascade Mountains, it is spread at an elevation of about six thousand feet above the sea over undulating grass-covered table-lands with *Pinus albicaulis*, *Abies lasiocarpa*, and *Tsuga Mertensiana*, and on Mt. Stewart it forms a straggling line of scattered trees at the upper limits of tree-growth, or, occasionally clinging to steep slopes facing the north, it forms small irregular groves at elevations of from five thousand five hundred to eight thousand feet above the sea.[3]

The wood of *Larix Lyallii* is heavy, hard, close-grained, and bright reddish brown, with thin nearly white sapwood. It contains broad dark resinous bands of small summer cells, few obscure resin passages, and many thin medullary rays. The specific gravity of the absolutely dry wood is 0.7077, a cubic foot weighing 44.10 pounds.[4]

Larix Lyallii was discovered on the Cascade Mountains in 1860 by David Lyall,[5] the surgeon and naturalist of the British Commission which marked the northern boundary of the United States west of the Rocky Mountains. It has not yet been cultivated.

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[1] Macoun, *Cat. Can. Pl.* 476.

[2] In 1883 *Larix Lyallii* was found on Mt. Stewart by Mr. T. S. Brandegee, who reported that it sometimes formed there trunks four feet in diameter. This is much larger than any of the trees I have seen in Alberta, where, although they are often sixty feet in height, the trunks rarely exceed twenty inches in diameter.

[3] The range of *Larix Lyallii* is still very imperfectly known. It is reported by Mr. John Macoun on a mountain six miles southwest of Morley, Alberta, at the unusually low altitude of four thousand five hundred feet above the sea-level. This is on the eastern slope of the Rocky Mountains, and the most easterly point where this tree has been seen. It is very abundant on the mountains near Laggan on the Canadian Pacific Railroad, not far from the continental divide, where it grows up to elevations of almost seven thousand feet above the sea; this is the most northerly point at which it has been reported. It is, however, so abundant here and of such large size that it probably ranges much farther northward along the Rocky Mountains, which are entirely unknown botanically from the line of the Canadian Pacific Railroad to the Athabasca Pass, eighty miles to the northward. It might be expected to range along both slopes of the Rocky Mountains south to northern Montana, but, although this region has been visited by botanists, there is no record that it does occur there.

[4] Sargent, *Garden and Forest*, iii. 356.

Larix Lyallii grows very slowly. The trunk in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut by Mr. T. S. Brandegee on Mt. Stewart, is sixteen and one half inches in diameter inside the bark and five hundred and sixty-two years old. The sapwood is three eighths of an inch in thickness, with thirty-two layers of annual growth.

[5] David Lyall (June 1, 1817 – March 2, 1895) was born at Auchinblae, in Kincardineshire, and received a medical education at Aberdeen, where he took his degree, having been previously admitted to the Royal College of Surgeons in Edinburgh. After graduating he made a voyage to Greenland as surgeon to a whaling ship, and, on his return, entering the Royal Navy in 1839, he was appointed assistant surgeon of H. M. S. Terror for service under Sir James Ross, in his scientific expedition to the antarctic regions. During this voyage, from which Dr. Lyall did not return until 1842, he devoted much attention to botany, making several important collections, and discovering in Kerguelen's Land the plant which was named for him by his brother officer, the younger Hooker, *Lyallia*. After returning from the antarctic expedition, Dr. Lyall served in the Mediterranean, and then as surgeon and naturalist on the Acheron, which was detailed to survey the coast of New Zealand. At this time he discovered the great white-flowered *Ranunculus Lyallii*, the largest of all the Buttercups. In 1852 he was appointed surgeon and naturalist to one of the vessels in the squadron sent under command of Sir E. Belcher in search of Sir John Franklin; and his collections of plants made in the American polar islands at this time added much to the knowledge of the distribution of the arctic flora. In 1858 Dr. Lyall served as surgeon and naturalist to the Boundary Commission under Sir John Hawkins, accompanying it in its survey of the boundary line between British Columbia and the United States from the Gulf of Georgia to the summit of the Rocky Mountains. An account of his botanical collection made on the boundary, with descriptions of the various zones of vegetation, was published in the seventh volume of the *Journal of the Linnæan Society*. After his return from North America he was on home duty until 1873, when he was retired. In addition to his paper on the botany of northwestern America, Dr. Lyall published, in the twentieth volume of the *Proceedings of the Zoölogical Society*, a paper on the habits of *Strigops habroptilus*, a New Zealand bird. (See Hooker f. *Jour. Bot.* xxxiii. 209.)

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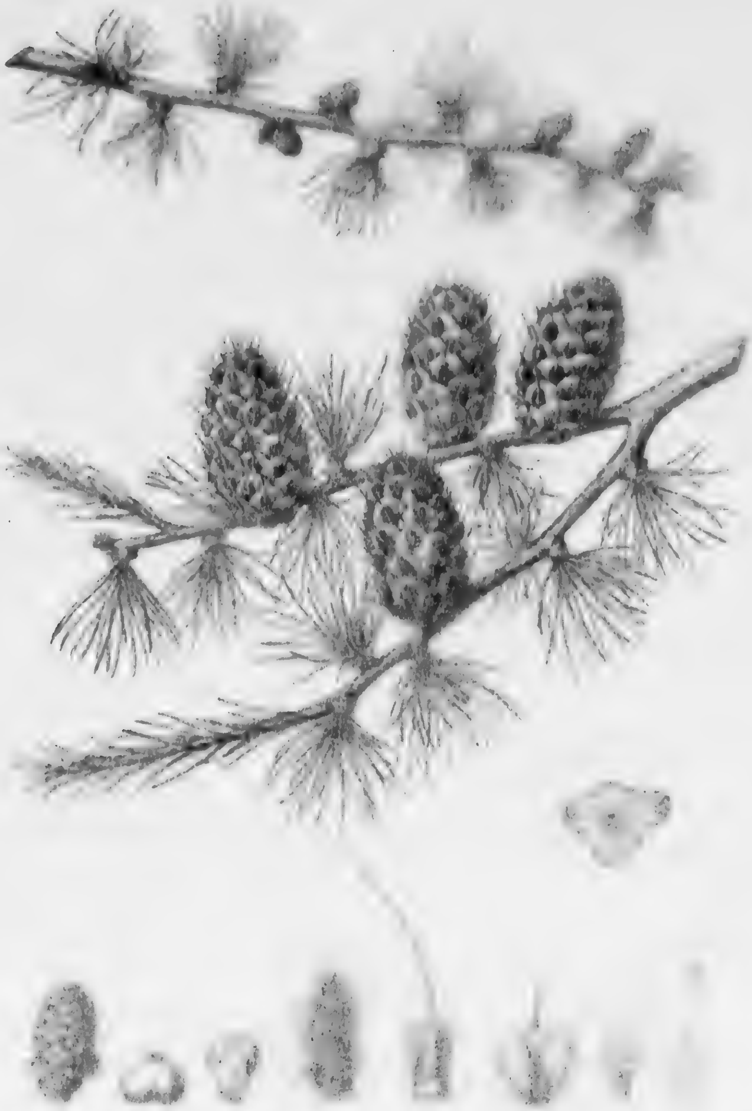
EXPLANATION OF THE PLATE.

Plate DXCV. Larix Lyallii.

1. A flowering branch, natural size.
2. A staminate flower, enlarged.
3. A stamen, front view, enlarged.
4. A stamen, seen from below, enlarged.
5. A pistillate flower, natural size.
6. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, upper side, with its seeds, natural size.
9. A seed, enlarged.
10. Vertical section of a seed, enlarged.
11. An embryo, enlarged.
12. Cross section of a leaf, magnified fifteen diameters.



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1. A [illegible]
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[illegible] and [illegible]
A fruiting branch, natural size.
8. A [illegible] upper side, with its seeds, natural size.
9. A seed, enlarged.
10. Vertical section of a seed, enlarged.
11. An embryo, enlarged.
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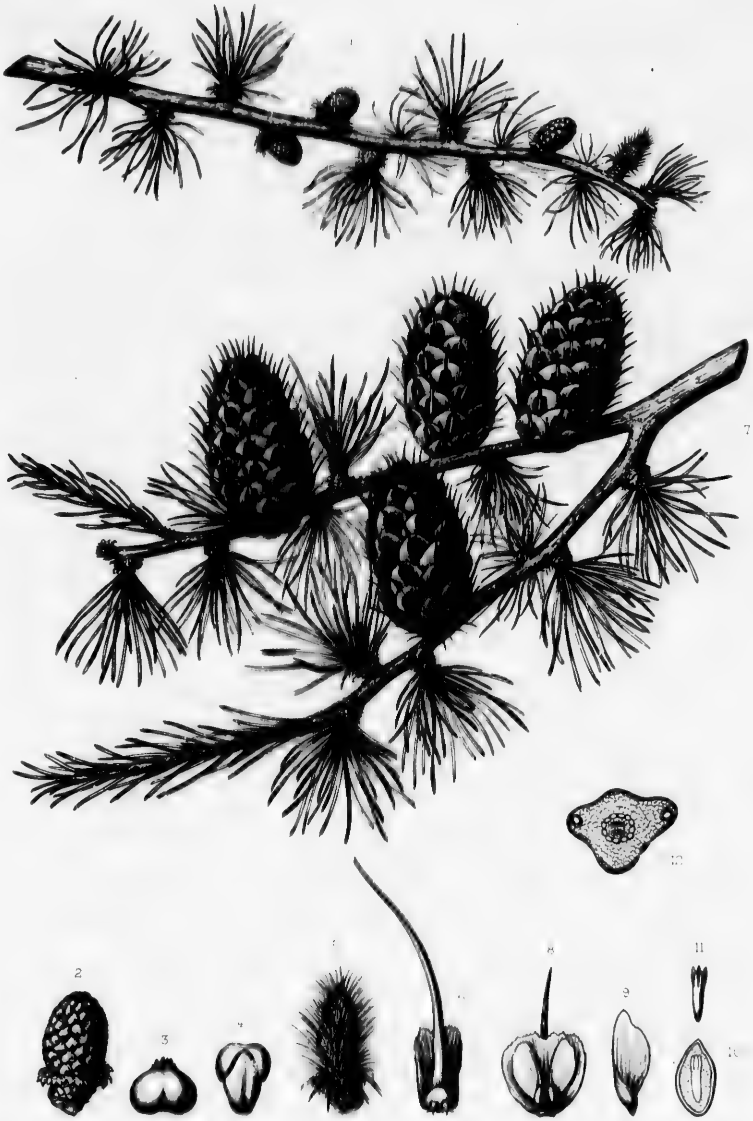

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PICEA.

Flowers solitary, naked, monœcious, the staminate axillary or terminal; stamens indefinite, anther-cells 2, surmounted by their crested connectives; pistillate flowers terminal or axillary; ovules 2, under each scale. Fruit a woody strobile maturing in one season. Leaves angular or flat, spirally disposed.

Picea, Link, *Abhand. Akad. Berl.* 1827, 179 (1830). — Engelmann, *Trans. St. Louis Acad.* ii. 211. — Bentham & Hooker, *Gen.* iii. 439. — Eichler, *Engler & Prantl, Pflanzenfam.* ii. pt. i. 77. — Masters, *Jour. Linn. Soc.* xxx. 28.

Abies, Linnæus, *Gen.* 294 (in part) (1737). — A. L. de Jussieu, *Gen.* 414 (in part). — D. Don, *Lambert Pinus*, iii. (1837).

Pinus, Linnæus, *Gen.* ed. 5, 434 (in part) (1754). — Endlicher, *Gen.* 260 (in part). — Meissner, *Gen.* 352 (in part). — Baillon, *Hist. Pl.* xii. 44 (in part).

Pyramidal trees, with tall tapering trunks often strongly buttressed at the base, thin scaly or rarely deeply furrowed bark, soft pale wood containing numerous resin canals, slender whorled horizontal limbs clothed with pendent often elongated twice or thrice ramified lateral branches, their ultimate divisions stout, glabrous or pubescent, thick roots wide spreading near the surface of the ground, and long flexible tough rootlets. Branch buds usually three, surrounded with numerous more or less developed acicular scales articulate on persistent bases and generally deciduous before the opening of the buds, the two lateral in the axils of upper leaves, and much smaller than the terminal bud, ovate, acute or obtuse, covered by numerous spirally arranged light chestnut-brown accrescent scales acute or rounded and on some species strongly reflexed at the apex, those of the first pair minute, opposite and lateral; outer scales thickening and long persistent at the base of the branchlet, the inner thin, scarious, slightly united into a cup-like cover, deciduous in one piece from the end of the young branchlet.[1] Leaves spirally disposed, densely packed and appressed in the bud and on the lengthening branchlets into cone-shaped clusters, ultimately extending out from the branch on all sides, or occasionally appearing two-ranked by the twisting of the petioles of those on the lower side, mostly pointing to the end of the branch, frequently somewhat incurved above the middle, acute or acuminate at the apex, with slender callous tips, or rarely obtuse, entire, longer and more slender on sterile branches than on fertile branches and leading shoots, articulate on persistent prominent rhombic ultimate woody bases, dark or light green and lustrous, or blue or bluish green, keeled above and below, tetragonal and stomatiferous with numerous rows of stomata on the four sides, or flattened and stomatiferous only on the upper surface and occasionally also on the lower, containing one or two lateral resin ducts close to the epidermis of the lower side, or destitute of resin ducts, persistent generally for from seven to ten years, deciduous in drying. Flowers appearing in early spring, monœcious,[2] terminal or in the axils of upper leaves on branchlets of the previous year from buds formed during the summer, surrounded at the base by involucres of the numerous enlarged scarious scales of their buds. Staminate flowers oblong, oval or cylindrical, erect, short-stalked or often nodding at maturity on long slender pedicels, composed of numerous spirally arranged yellow or scarlet anthers opening longitudinally, their connectives produced into broad nearly circular toothed crests; pollen-grains bilobed with lateral air-sacs. Pistillate flowers erect on short stalks, oblong-cylindrical, pale yellow-green or scarlet, composed of numerous rounded or pointed scales usually broader than long, entire or denticulate on the margins, spirally imbricated in many ranks, bearing on their inner face near the base two inverted collateral ovules, each scale in the axil of an oblong generally acute or acuminate or of a nearly orbicular bract, at first much longer but before the fecundation of the ovules usually much shorter than the quickly accrescent scales. Fruits ovoid or oblong-cylindrical pendulous sessile or short-stalked cones maturing in one season, crowded on the topmost branches, or on some species scattered over the upper half of the tree, deciduous during the first winter or persistent on the branch for many years, their scales obovate, rounded above with entire or denticulate margins, or oblong and often more or less narrowed to both ends, with nearly entire, dentate, erose or laciniate margins, much longer than their bracts, gradually decreasing in size to the two ends of the cone, the upper and lower usually sterile, persistent on the axis of the cone after the escape of the seeds. Seeds geminate, reversed, attached at the base in shallow depressions on the inner face of the cone-scales, ovoid or oblong, full and rounded on the sides, usually acute at the base, in falling bearing away portions of the membranaceous lining of the scale, forming oblong wing-like attachments longer than the seeds, and inclosing them except on their upper side; testa of two coats, the outer crustaceous, light or dark brown, the inner membranaceous, pale chestnut-brown and lustrous. Embryo axile in conspicuous fleshy albumen; cotyledons from four to fifteen, and, like the primary leaves, denticulate on the margins.[3]

Picea, which often forms great forests on boreal plains and high mountain slopes, is widely distributed through the colder and temperate regions of the northern hemisphere, ranging from the Arctic Circle to the high slopes of the southern Appalachian Mountains, and to New Mexico and Arizona in the New World, and in the Old World to central and southeastern Europe, the Caucasus, the Himalayas, and Japan. Sixteen species are now usually recognized, but it is not improbable that a more accurate knowledge of the Spruce-trees of northeastern continental Asia than it is now possible to obtain may increase the number. The forests of North America contain seven species; of these one species crosses the northern part of the continent from the shores of the Atlantic Ocean to those of Behring Sea; another ranges from the east to beyond the Rocky Mountains; one species is peculiar to the Appalachian Mountain system; two species belong to the silva of the Rocky Mountains; another is confined to the northwest coast, and one, probably the least widely distributed of the whole genus, grows only on a few of the high mountains of northern California and southern Oregon. In Japan *Picea bicolor*[4] and *Picea Torano*[5] are scattered, usually singly, through the forests of Beeches and Oaks which cover the mountains of central Hondo. *Picea Jezoensis*[6] ranges from southern Yezo to the coast of Manchuria, and *Picea Glehni*[7] also reaches Yezo from the north. On the temperate Himalayas *Picea Smithiana*[8] forms great forests, and on many of the mountains of Asia Minor and on the Caucasus is replaced by *Picea orientalis*;[9] farther westward *Picea Omorika*[10] represents the genus on the Balkan ranges; and in western Europe *Picea Abies*[11] is a common inhabitant of mountain forests, and at the north often covers great plains, while in northern Asia its place is taken by *Picea obovata*.[12] The type is an ancient one, and Spruces very similar to those now living inhabited Europe during the miocene period.[13]

Picea, which contains some of the most valuable timber-trees in the northern hemisphere, produces soft straight-grained pale wood and resinous exudations sometimes used in medicine. Many of the species, which can be easily raised from seeds and generally grow rapidly, are used to decorate the parks and gardens of all northern countries.

Picea is often seriously injured by insects,[14] and is subject to a number of fungal diseases.[15]

Picea, which was probably the classical name of the Spruce, was first used by Link as the generic name of the Spruces as the genus is now limited.[16]

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[1] Henry, *Nov. Act. Cæs. Leop.* xix. 97, t. 13.

[2] Androgynous flowers of *Picea Abies* have been noticed by Masters (*Vegetable Teratology*, 192), and a similar phenomenon has been found by J. G. Jack on two plants of *Picea Canadensis*. (See *Garden and Forest*, viii. 222, f. 33, 1.)

[3] The species of Picea with tetragonal and with flat leaves may be grouped in two sections, as suggested by Engelmann (*Gard. Chron.* n. ser. xi. 334 [1879]), and by Willkomm (*Forst. Fl.* ed. 2, 66 [1887]): —

EUPICEA. Leaves tetragonal, stomatiferous on all sides.

OMORIKA. Leaves flattened, usually stomatiferous only on the upper side.

[4] *Picea bicolor*, Mayr. *Monog. Abiet. Jap.* 49, t. 3, f. 8 (1890).

Abies Alcoquiana, Lindley, *Gard. Chron.* 1861, 23 (in part). — K. Koch, *Dendr.* ii. pt. ii. 245 (in part).

Abies bicolor, Maximowicz, *Bull. Acad. Sci. St. Pétersbourg*, x. 488 (*Mél. Biol.* vi. 24) (1866). — Franchet & Savatier, *Enum. Pl. Jap.* i. 467.

Picea Alcockiana, Carrière, *Traité Conif.* ed. 2, 343 (1867.) — Masters, *Gard. Chron.* n. ser. xii. 212, f. 41, 43 ; *Jour. Linn. Soc.* xviii. 508, f. 7–9 (*Conifers of Japan*). — Hennings, *Gartenflora*, xxxviii. 216, f. 40.

Pinus Alcoquiana, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 417 (1868).

Abies Alcockiana, Gordon, *Pinetum*, ed. 2, 4 (not Lindley) (1875).

Picea bicolor, which is probably rare and not widely distributed, is a tree seldom more than seventy or eighty feet in height, with a trunk sometimes two feet in diameter, tetragonal leaves, and stout cones five or six inches in length, with thin rounded scales which are slightly denticulate on the margins and become reflexed at maturity. It appears to exist in American gardens only in a very young state, and to be exceedingly rare in Europe. In the mountains of Japan the old trees with their feeble branches and sparse foliage possess little beauty.

[5] *Picea Torano*, Koehne, *Deutsche Dendr.* 22 (1893).

? *Pinus Abies*, Thunberg, *Fl. Jap.* 275 (not Linnæus) (1784).

? *Pinus Thunbergii*, Lambert, *Pinus*, ii. Preface, p. v. (1824).

Abies Torano, Siebold, *Verhand. Batav. Genoot. Konst. Wet.* xii. 12 (1830). — K. Koch, *l. c.* 233.

? *Abies Thunbergii*, Lindley, *Penny Cycl.* i. 34 (1833).

Abies polita, Siebold & Zuccarini, *Fl. Jap.* ii. 20, t. 111 (1842). — Miquel, *Ann. Mus. Bot. Lugd. Bat.* iii. 167 (*Prol. Fl. Jap.*). — Franchet & Savatier, *l. c.* 466. — Gordon, *l. c.* 16.

Pinus polita, Antoine, *Conif.* 95, t. 36, f. 1 (1840–47). — Endlicher, *Syn. Conif.* 121. — Parlatore, *l. c.*

Picea polita, Carrière, *Traité Conif.* 256 (1855). — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 85. — Masters, *Gard. Chron.* n. ser. xiii. 233, f. 44 ; *Jour. Linn. Soc.* xviii. 507 (*Conifers of Japan*). — Mayr, *l. c.* 46, t. 3, f. 7. — Beissner, *Handb. Nadelh.* 380, f. 102.

Abies Smithiana, Gordon, *Pinetum*, 12 (in part) (not Loudon) (1858).

On the Nikkō Mountains *Picea Torano* is a stunted tree thirty or forty feet in height, with a thin top and short ragged branches ; it is distinguished by its stout rigid falcate tetragonal sharp-pointed yellow-green leaves, and by its broadly ovate cones from four to six inches in length, with rounded scales thin, entire or slightly fimbriated on the margins. Ugly and unattractive in its native forests, *Picea Torano* is one of the hardiest of the Asiatic Spruce-trees in the gardens of the United States and England, into which it was introduced thirty or forty years ago, and in which, still retaining the dense habit and the shapely form of youth, it produces cones abundantly every season.

[6] *Picea Jezoensis*, Carrière, *l. c.* 255 (1855). — Beissner, *l. c.* 389.

Abies Jezoensis, Siebold & Zuccarini, *l. c.* t. 110 (1842). — Miquel, *l. c.*

Pinus Jezoensis, Antoine, *l. c.* 97, t. 37, f. 1 (1840–47). — Endlicher, *l. c.* 120.

Abies Ajanensis, Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 212 (1850). — Maximowicz, *Bull. Phys. Math. Acad. Sci. St. Pétersbourg*, xv. 436 (*Bäume und Sträucher des Amurlands*).

Picea Ajanensis, Trautvetter & Meyer, *Middendorff Reise*, i. pt. ii. 87, t. 22–24 (*Fl. Ochot.*) (1856). — Carrière, *l. c.* 259. — Regel & Tilling, *Fl. Ajan.* 119. — Maximowicz, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 261 (*Prim. Fl. Amur.*). — Regel, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, iv. No. 4, 136 (*Tent. Fl. Ussur.*). — Masters, *Gard. Chron.* n. ser. xiii. 115, f. 22; xiv. 427, f. 80–84, ser. 3, iii. 53, f. 10 ; *Jour. Linn. Soc.* xviii. 508, f. 8–10 (*Conifers of Japan*). — Trautvetter, *Act. Hort. Petrop.* ix. 212 (*Incrementa Fl. Ross.*). — Hennings, *l. c.* — Mayr, *l. c.* 53, t. 4, f. 10. — Beissner, *l. c.* 386, f. 104.

Picea Ajanensis, *α genuina*, Trautvetter & Meyer, *l. c.* (1856).

Picea Ajanensis, *β subintegerrima*, Trautvetter & Meyer, *l. c.* (1856).

Abies microsperma, Lindley, *Gard. Chron.* 1861, 22. — Gordon, *Pinetum*, Suppl. 12. — A. Murray, *Proc. R. Hort. Soc.* ii. 429, f. 111–118; *The Pines and Firs of Japan*, 69, f. 129–136.

Abies Alcoquiana, Lindley, *l. c.* 1861, 23 (in part). — A. Murray, *Proc. R. Hort. Soc.* ii. 426, f. 98–110 ; *The Pines and Firs of Japan*, 66, f. 116–128. — Gordon, *l. c.* 8.

Picea microsperma, Carrière, *Traité Conif.* ed. 2, 339 (1867).

Pinus Menziesii, Parlatore, *l. c.* 418 (in part) (not D. Don) (1868).

Pinus Japonica, Parlatore, *l. c.* (1868).

Abies Sitchensis, K. Koch, *l. c.* ii. pt. ii. 247 (in part) (not Lindley & Gordon) (1873).

Abies Menziesii, Franchet & Savatier, *l. c.* 467 (not Lindley) (1875).

Picea Ajanensis, var. *microsperma*, Masters, *Gard. Chron.* n. ser. xiii. 115 (1880); *Jour. Linn. Soc.* xviii. 509 (*Conifers of Japan*).

Abies Ajanensis, var. *microsperma*, Veitch, *Man. Conif.* 66 (1881).

Tsuga Ajanensis, Regel, *Russ. Dendr.* ed. 2. pt. i. 39 (1882).

Picea Hondoënsis, Mayr, *l. c.* 51, t. 4, f. 9 (1890).

Picea Jezoensis is a tree from eighty to one hundred feet in height, with slender branches, flat leaves dark green and lustrous below and silvery white above, and slender cones from two to four inches in length, with more or less pointed laciniately cut scales. It bears a strong superficial resemblance to *Picea Sitchensis* of the northwest coast of North America, from which it, however, differs in its flatter and generally blunter leaves and in the minute suborbicular bracts of the cone-scales.

This is the common Spruce-tree of Yezo, where, on low rocky hills, it is scattered through the forests of deciduous-leaved trees, either singly or in small groves, and in the western part of the island forms forests on swampy ground not much above the level of the ocean. It is also common on Saghalin and the coast of Manchuria, where it is said to grow in extensive forests.

Picea Jezoensis is usually called in American and English gardens *Picea Alcoquiana*, one of the synonyms of *Picea bicolor* ; in the eastern United States, where there are cone-bearing specimens from twenty-five to thirty feet in height, it has proved very hardy and one of the most beautiful of the exotic Spruces, especially in early spring, when it may be distinguished by the bright scarlet color of the young leaves when they first emerge from the buds.

[7] *Picea Glehni*, Masters, *Gard. Chron.* n. ser. xiii. 300, f. 54 (1880); *Jour. Linn. Soc.* xviii. 513, f. 13 (*Conifers of Japan*); *Jour. R. Hort. Soc.* xiv. 222. — Mayr, *l. c.* 56, t. 4, f. 11. — Beissner, *l. c.* 377.

Abies Glehni, Fr. Schmidt, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, xii. 176, t. 4, f. 8–12 (*Fl. Sachalinensis*) (1868). — Veitch, *l. c.* 80.

Little is known of this tree, which was discovered on the island of Saghalin, and which grows, also, at a few points near the southern coast of Yezo. It is clearly related to the Siberian *Picea* *obovata*, of which it is, perhaps, only an extreme form. A large number of seedlings have been raised in the Arnold Arboretum, but they are still too young to show whether this tree is likely to flourish in the eastern United States.

[8] *Picea Smithiana*, Boissier, *Fl. Orient.* v. 700 (1884).

Pinus Smithiana, Wallich, *Pl. Asiat. Rar.* iii. 24, t. 246 (1832). — D. Don, *Lambert Pinus*, iii. t. — Antoine, *Conif.* 95, t. 36 bis. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 416.

Abies Smithiana, Lindley, *Penny Cycl.* i. 31, f. (1833). — Loudon, *Arb. Brit.* iv. 2317, f. 2229. — Forbes, *Pinetum Woburn.* 103, t. 36. — Madden, *Jour. Agric. and Hort. Soc. Ind.* iv. pt. iv. 230; vii. pt. iv. 87. — Gordon, *Pinetum*, 12. — Cleghorn, *Jour. Agric. and Hort. Soc. Ind.* xiv. pt. ii. 266, t. 5 (*Pines of the Northwest Himalayas*). — Herder, *Bull. Soc. Nat. Mosc.* xli. 423. — K. Koch, *Dendr.* ii. pt. ii. 232.

Abies spinulosa, Griffith, *Itin.* i. 145 (1848); *Icon. Pl. Asiat.* t. 363.

Pinus Khutrow, Royle, *Ill.* 353, t. 84, f. 1 (1839). — Antoine, *l. c.* 94, t. 36, f. 2. — Endlicher, *Syn. Conif.* 122.

Picea Morinda, Link, *Linnæa*, xv. 522 (1841). — Carrière, *Traité Conif.* ed. 2, 340. — Hooker f. *Fl. Brit. Ind.* v. 653. — Beissner, *Handb. Nadelh.* 373.

Abies Khutrow, Loudon, *Encycl. Trees*, 1032, f. 1951 (1842). — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 21.

Picea Khutrow, Carrière, *Traité Conif.* 258 (1855). — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 85.

Abies Morinda, (Nelson) Senilis, *Pinaceæ*, 49 (1866).

Picea Smithiana is a tree from one hundred to one hundred and twenty or occasionally one hundred and fifty feet in height, with a trunk often four or five and occasionally seven feet in diameter, pale scaly bark, wide-spreading branches, long pendulous branchlets, slender four-sided pale green leaves, and cylindrical obtuse cones from four to six inches in length, with thin broadly obovate, rounded usually entire scales cuneate at the base. The Himalayan Spruce is generally found on northern and western slopes between elevations of six thousand and eleven thousand feet above the sea-level, growing rarely in pure forests, but most commonly mixed with deciduous-leaved trees and with *Cedrus Deodara*, *Pinus Nepalensis*, and *Abies Webbiana*; it is distributed from Afghanistan to Sikkim and Bhotan, where it is found only in the valleys at elevations of from seven thousand eight hundred to ten thousand feet.

The wood of *Picea Smithiana*, which is not durable, is used for packing-cases and the interior finish of buildings, and occasionally for shingles (Gamble, *Man. Indian Timbers*, 407). The bark is employed for the roofs of huts and water-troughs, and the branches for fodder and manure. In northwestern India the young cones are used in medicine. (See Brandis, *Forest Fl. Brit. Ind.* 525.)

Picea Smithiana was introduced into Scotland in 1818, and has proved a hardy, fast-growing, and desirable ornamental tree in the countries of temperate Europe. (See Masters, *Gard. Chron.* n. ser. xxiv. 393, f. 85. — Webster, *Trans. Scottish Arboricultural Soc.* xi. 57. — Dunn, *Jour. R. Hort. Soc.* xiv. 85.)

In the middle Atlantic states, where the largest plants are still small (see *Garden and Forest*, vi. 458), and in California, the Himalayan Spruce has proved hardy, but it has not succeeded in New England.

[9] *Picea orientalis*, Carrière, *l. c.* 244 (1855). — Tchihatcheff, *Asie Mineure*, ii. 495 (excl. hab. northern Russia, Siberia, and the Kurile Islands). — Boissier, *l. c.* — Masters, *l. c.* xxv. 333, f. 62; ser. 3, iii. 754, f. 101. — Beissner, *l. c.* 374, f. 100.

Pinus orientalis, Linnæus, *Spec.* ed. 2, 1421 (1763). — Lambert, *Pinus*, i. 45, t. 29, f. a. — Marschall von Bieberstein, *Fl. Taur.-Cauc.* ii. 409. — Steven, *Bull. Soc. Nat. Mosc.* xi. 48; *Ann. Sci. Nat.* sér. 2, xi. 57. — Antoine, *l. c.* 89, t. 35, f. 1. — Endlicher, *l. c.* 116. — Ledebour, *Fl. Ross.* iii. 671 (in part). — K. Koch, *Linnæa*, xxii. 296. — Turczaninow, *Fl. Baicalensi-Dahurica*, ii. 139. — Christ, *Verhand. Nat. Gesell. Basel*, iii. 546 (*Uebersicht der Europäischen Abietineen*). — Parlatore, *l. c.* 414.

Abies orientalis, Poiret, *Lamarck Dict.* vi. 518 (1804). — Lindley, *l. c.* — Jaubert & Spach, *Pl. Orient.* i. 30, t. 14. — K. Koch, *Dendr.* ii. pt. ii. 239.

Pinus obovata, Turczaninow, *Bull. Soc. Nat. Mosc.* xi. 101 (*Cat. Pl. Baical.*) (1838).

A tree, frequently one hundred and fifty feet in height, with a trunk often four feet in diameter, *Picea orientalis* forms extensive forests up to elevations of six or seven thousand feet above the sea. It is distinguished by its narrow pyramidal crown of slender limbs, which sweep upward in graceful curves and are clothed with short rigid lateral branches, by its short dark green and lustrous tetragonal leaves closely pressed against the pubescent branchlets, which therefore appear unusually slender, and by its narrow cylindrical acute cones from two to three inches in length, with broad rounded scales thin and entire on the margins.

Picea orientalis was introduced into the gardens of western Europe in 1825, and for at least fifty years it has inhabited those of the eastern United States, where it has proved itself perfectly hardy as far north as eastern Massachusetts and one of the most beautiful and desirable of all the exotic conifers which have been well tested here.

A dwarf form and one with yellow leaves are occasionally cultivated in European collections (Beissner, *l. c.* 376).

[10] *Picea Omorika*, Bolle, *Monats. Beförd. Gartenb. Preuss. Staat.* 1877, 124, 158 (*Die Omorica-Fichte*) (1877). — Purkyne, *Osterr. Monats. Forstw.* 1877, 446. — A. Braun, *Sitz. Bot. Ver. Prov. Brandenburg*, 1877, 45. — Reichenbach f. *Bot. Zeit.* xxxv. 118. — Willkomm, *Cent. Gesell. Forst.* 1877, 365 (*Ein neuer Nadelholzbaum Europas*); *Forst. Fl.* ed. 2, 99; *Wien Ill. Gart.-Zeit.* 1885, 494. — Carrière, *Rev. Hort.* 1877, 259. — P. Ascherson & A. Kanetz, *Cat.* 7. — Boissier, *l. c.* 701. — Masters, *l. c.* vii. 470, 620; xxi. 308, f. 56, 58; *Jour. Linn. Soc.* xxii. 203, t. 8; *Jour. R. Hort. Soc.* xiv. 223. — Bornmüller, *Österr. Bot. Zeit.* xxxvii. 398. — P. Ascherson, *Österr. Bot. Zeit.* xxxviii. 34. — Stein, *Gartenflora*, xxxvi. 13, t. 4, 5. — Wettstein, *Sitz. Math.-nat. Akad. Wiss. Wien*, xcix. pt. i. 503, t. 1–5. — Beissner, *l. c.* 382, f. 109. — Koehne, *Deutsche Dendr.* 20, f. 8, N. — Hempel & Wilhelm, *Bäume und Sträucher*, i. 82, f. 41, 42.

Pinus Omorika, Pančić, *Eine neue Conifere in den Östlichen Alpen*, 4 (1876).

Abies Omorika, Nyman, *Conspect. Fl. Europ.* 673 (1881); Suppl. ii. 283.

Picea Omorika, which forms great forests and is probably generally distributed at high elevations over all the region between the Adriatic and the Black Sea, is described as a lofty tree with short branches which form a narrow crown, red-brown bark separating freely in large thin scales, usually flat obtuse or acute leaves, dark green and lustrous below, and silvery white above from the numerous bands of stomata on each side of the prominent midrib, and oblong-oval cones at first horizontal and finally pendent, about two inches in length, violet-colored while young and ultimately reddish brown and lustrous, with thin rounded striate scales slightly and irregularly denticulate on the margins.

Although one of the largest and most valuable timber-trees of Europe, and particularly interesting in its relationship to a species of the coast of northeastern Asia and to the two species peculiar to the northwest coast of North America, *Picea Omorika* escaped the attention of botanists until comparatively recent years, but under the name of Omorika it has long been a familiar tree to the inhabitants of the region where it grows.

In 1881 *Picea Omorika* was raised from seeds in the Arnold Arboretum, where it has proved hardy and has grown rapidly, promising to attain a large size; it also flourishes in Great Britain (*Gard. Chron.* ser. 3, xxi. 153, f. 14).

[11] *Picea Abies*, Karsten, *Pharm.-med. Bot.* 324, f. 155 (1881).

Pinus Abies, Linnæus, *Spec.* 1002 (1753). — Lambert, *Pinus*, i. 37, t. 25. — Wahlenberg, *Fl. Lapp.* 256; *Fl. Ups.* 320. — Antoine, *Conif.* 90, t. 35, f. 2. — Endlicher, *Syn. Conif.* 117. — Ledebour, *Fl. Ross.* iii. 670. — Koch, *Syn. Fl. German.* ed. 3, 578.

Abies Picea, Miller, *Dict.* ed. 8, No. 3 (1768). — Spach, *Hist. Vég.* xi. 405.

Pinus Abies Picea, Muenchhausen, *Hausv.* v. 223 (1770).

Pinus Picea, Du Roi, *Obs. Bot.* 37 (not Linnæus) (1771); *Harbk. Baumz.* ii. 110. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 30. — Reichenbach, *Icon. Fl. German.* xi. 4, t. 532 (*Abies excelsa* on plate). — Christ, *Verhand. Nat. Gesell. Basel*, iii. 545 (*Uebersicht der Europäischen Abietineen*). — Parlatore, *Fl. Ital.* iv. 62; *De Candolle Prodr.* xvi. pt. ii. 415.

Pinus excelsa, Lamarck, *Fl. Franç.* ii. 202 (1778). — Salisbury, *Trans. Linn. Soc.* viii. 314.

Abies pectinata, Gilibert, *Exercit. Phyt.* ii. 411 (1792).

Pinus cinerea, Borkhausen, *Forstbot.* i. 398 (1800). — Roehling, *Deutschl. Fl.* ed. 2, 519.

Abies excelsa, De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 275 (1805). — Poiret, *Lamarck Dict.* vi. 518. — *Nouveau Duhamel*, v. 289, t. 80. — Richard, *Comm. Bot. Conif.* 69, t. 14, f. 2, 15. — Lindley, *Penny Cycl.* i. 31, f. — Schouw, *Ann. Sci. Nat.* sér. 3, iii. 239 (*Conifères d'Italie*). — Hartig, *Forst. Culturpfl. Deutschl.* 17, t. 1. — Fiscali, *Deutsch. Forstcult.-Pfl.* 23, t. 1, f. 13–20. — Gordon, *Pinetum*, 3. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 17. — K. Koch, *Dendr.* ii. pt. ii. 234. — Colmeiro, *Enum. Pl. Hispano-Lusitana*, iv. 709.

Picea vulgaris, Link, *Abhand. Akad. Berl.* 1827, 180 (1830). — Herder, *Bot. Jahrb.* xiv. 160 (*Fl. Europ. Russlands*).

Picea excelsa, Link, *Linnæa*, xv. 517 (1841). — Carrière, *Traité Conif.* 245. — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 85. — Beissner, *Handb. Nadelh.* 351. — Hempel & Wilhelm, *Bäume und Sträucher*, i. 58, f. 28–40, t. 1.

Picea montana, Schur, *Verh. Seibenb. Ver. Naturw.* ii. 159 (1851).

One of the loftiest of the trees of Europe, the type of the genus and its best known representative, *Picea Abies* frequently attains a height of one hundred and twenty and occasionally of one hundred and fifty feet, with a trunk from four to six feet in diameter and wide-spreading lower branches which even old trees do not lose unless crowded in the forest, and which, sweeping over the surface of the ground in graceful upward curves, occasionally develop roots in moist soil and send up secondary stems, forming small groves around the parent tree. (See M'Nab, *Gard. Mag.* xiii. 249, f. 87–92. — Schübeler, *Virid. Norveg.* i. 416, f. 73–77. — Christ, *Garden and Forest*, ix. 252.) The European Spruce is distinguished by its dark green lustrous sharp-pointed tetragonal leaves rarely more than an inch in length, yellow staminate flowers more or less tinged with red, obtuse bright scarlet pistillate flowers, and cylindrical pointed cones which when fully grown are pale green or green shaded with red, especially on the side exposed to the light, and at maturity are from five to seven inches in length and from an inch and a half to two inches thick, with rhomboidal incurved scales irregularly toothed at the apex.

Picea Abies is distributed from about latitude 67° north in Norway and 68° 15′ in western Russia, southward to the Pyrenees, the Maritime Alps, the Euganian Hills in Lombardy, and central Russia. Most abundant in Scandinavia, where at the north it grows at the sea-level, and in northern Germany, it also often forms extensive forests on the mountains of central Europe, which it frequently ascends to altitudes of six or seven thousand feet, but does not grow spontaneously in Denmark, Holland, Belgium, western France, or in Great Britain, Turkey, or southern Russia.

The wood of *Picea Abies*, known in England as white deal, is light, tough, elastic, more or less durable according to the soil on which it has grown, lustrous, and pale reddish or yellowish white, with straight even grain and few resin ducts; it is employed in large quantities in construction and the interior finish of buildings, and for fuel. Its homogeneousness of structure with its thin medullary rays, makes it especially valuable for the transmission of sonorous vibrations, and in Europe it is almost exclusively used in the manufacture of pianos, violins, and other musical instruments, the best wood for this purpose being obtained from old trees which have grown slowly at high elevations. It is also largely used in the manufacture of matches and for paper pulp. (See Mathieu, *Fl. Forestière*, ed. 3, 471.)

From the resinous exudations of *Picea Abies* Burgundy Pitch is produced. This is an astringent opaque yellow-brown hard and brittle substance with an agreeable aromatic odor, and is obtained by making in the stem numerous perpendicular incisions about an inch and a half in width and depth in which the resin collects. From time to time this is scraped off with an iron instrument and is purified by being melted with steam or in hot water and strained. Burgundy Pitch, which was well known in England three centuries and a half ago (see Parkinson, *Theatr.* 1542), and was included in the London Pharmacopœia of 1677, is used as a mild stimulant in the preparation of medical plasters, and in Germany, mixed with colophony or gallipot, is employed to line beer-casks. The wounding of the trees to obtain their resinous product has been shown, however, to be injurious to the timber, and it is no longer permitted in the German state forests; and Burgundy Pitch is now largely replaced in commerce by artificial compounds, the one most frequently sold being made by melting colophony with Palm-oil or some other fat, opaqueness being obtained by stirring with water. (See Loudon, *Arb. Brit.* iv. 2307. — Guibourt, *Hist. Drog.* ed. 7, ii. 256. — Flückiger & Hanbury, *Pharmacopœia*, 556. — Bentley & Trimen, *Med. Pl.* iv. 261, t. 261. — Spons, *Encyclopædia of the Industrial Arts, Manufactures, and Raw Commercial Products*, ii. 1679. — *U. S. Dispens.* ed. 16, 1172. — Bastin & Trimble, *Am. Journ. Pharm.* lxviii. 418.)

The bark of *Picea Abies* is occasionally employed in tanning leather; in Scandinavia the young shoots are sometimes used for the winter fodder of cattle and sheep; baskets are made from the inner bark; and from the long slender flexible roots, which are first split and boiled, strong cords are twisted. (See Loudon, *l. c.* 2304.)

In the extreme northern portions of the Scandinavian peninsula, in Finland and northern Russia, the Spruce, which there rarely exceeds thirty feet in height, is distinguished from the tree of more southern countries, with which it appears to be connected by intermediate forms, by its shorter, thicker, and more rigid and obtuse leaves, conspicuously marked by four white stomatiferous bands, and by its short cones with thin scales rounded and entire on the margins. This is

Picea Abies medioxima.

Abies orientalis, Fries, *Bot. Notiser*, 1857, 174; 1858, 61, 199 (not Poiret).

Pinus Abies, var. *medioxima*, Nylander, *Bull. Soc. Bot. France*, x. 501 (1863).

Abies excelsa, var. *medioxima*, Hisenger, *Bot. Notiser*, 1867, 49, t.

Abies medioxima, Lawson, *Pinetum Brit.* ii. 159, f. 1–10 (1870).

Pinus Picea medioxima, Christ, *Flore de la Suisse*, 254 (1883).

Picea excelsa, β *medioxima*, Willkomm, *Forst. Fl.* ed. 2, 75 (1887). — Beissner, *Handb. Nadelh.* 356. — Koehne, *Deutsche Dendr.* 23.

The same form occurs in more or less isolated clumps at high elevations on the central ranges of the Swiss Alps, where it is believed to have existed since the glacial period, and, with its northern prototype, to indicate the close relationship between the Spruce of Europe and the Siberian *Picea obovata*. (See Dammer, *Gard. Chron.* ser. 3, iv. 479. — Christ, *Garden and Forest*, ix. 273.)

The tendency of *Picea Abies* to depart from its normal form is also shown by a number of curious varieties. Some of these are due to climatic influences and others to seminal variation. Of the former the most distinct are the small columnar trees with short tufted branches, stunted probably by the short summers and severe winters of northern Scandinavia and Finland, where individuals with this habit are not uncommon (see Schübeler, *Virid. Norveg.* i. 406, f. 66, 68. — Christ, *l. c.*), and the numerous bushy plants dwarfed by cold which often grow near the timber line on the high mountains of central Europe. (See Brugg, *Gartenflora*, xxxvi. 346. — Beissner, *l. c.* 357.)

The most curious and remarkable seminal forms of *Picea Abies* are the so-called Snake Spruces, with long slender remote and usually pendulous branches nearly destitute of lateral branchlets and covered with crowded closely appressed leaves, and elongated leading shoots. A plant of this character was discovered by Alstroemer in 1777, near Stockholm, which he identified with Linnæus's γ *Abies procera viminalis* (*Fl. Suec.* 288 [1745]). This is, therefore : —

Picea Abies viminalis.

Pinus viminalis, Alstroemer, *Vet. Akad. Handl. Stockh.* 1777, 310, t. 8, 9. — Borkhausen, *Forstbot.* i. 399. — Roehling, *Deutschl. Fl.* ed. 2, 529.

Pinus Abies, δ *viminalis*, Willdenow, *Spec.* iv. pt. i. 507 (1805). — Wahlenberg, *Fl. Suec.* 630.

Picea excelsa, β *viminalis*, Willkomm, *Forst. Fl.* 66 (1877). — Beissner, *l. c.* 360.

A number of individuals of this character have been found during the last century in southern Sweden, and others have appeared from time to time in the forests of different parts of Germany. The best known form of these German trees is

Picea Abies virgata.

Abies excelsa, var. *virgata*, Jacques, *Ann. Soc. Hort. Paris*, xliv. 653 (1853).

Picea excelsa denudata, Carrière, *Rev. Hort.* 1854, 101, f. 7; *Traité Conif.* 249.

Abies excelsa denudata, Gordon, *Pinetum*, Suppl. 3 (1862).

Picea excelsa, var. *virgata*, Caspary, *Schrift. Phys. Oek. Gesell. Königsberg*, xiv. 125, t. 15, 16 (1873). — Willkomm, *Forest Fl.* ed. 2, 75. — Beissner, *l. c.* 359.

This is hardly different from the Swedish form except in the somewhat more remote branches which distinguish some individuals, and Schübeler, who has given much attention to these monstrous forms of *Picea Abies*, does not separate them. (See *Virid. Norveg.* i. 410, f. 69.) The plants grown in gardens under the name of var. *monstrosa* belong to the group of Snake Spruces and differ considerably among themselves in the degree of their variation from the normal form of the Norway Spruce.

Among other seminal forms of *Picea Abies* is one with branches which, ascending at narrow angles, give to the tree the form of the Lombardy Poplar. This occurs on the Swiss Alps (see Christ, *l. c.* 252), and is probably similar to the plant propagated by nurserymen as var. *pyramidalis*, or perhaps identical with it. Another form which also grows sparingly on the Swiss Alps (see Christ, *l. c.*) is peculiar in its pendent limbs clothed with elongated slender branchlets which descend vertically. Plants of this general character with branches more or less pendulous are frequently cultivated as vars. *pendula* and *inverta*. Another specialized form of the Swiss Alps, var. *strigosa* (*Picea excelsa*, var. *strigosa*, Christ, *l. c.* [1896]), has numerous slender horizontal branches clothed with many branchlets which spread in all directions and give the trees the general aspect of a Larch.

Numerous dwarf varieties of *Picea Abies* with short crowded leaves are cultivated in gardens; they are either low pyramidal bushes or cushion-like plants sometimes only one or two feet high, with branches hugging the ground and spreading out into broad mats. (For enumerations of the garden varieties of *Picea Abies*, see Carrière, *Traité Conif.* ed. 2, 328. — Veitch, *Man. Conif.* 70. — Beissner, *l. c.* 357.)

For centuries *Picea Abies* has been a favorite ornament of the parks and gardens of northern and temperate Europe; and no other conifer has been more generally and successfully used in the mountain plantations of France, Germany, and Russia, although this Spruce suffers seriously from the ravages of the larvæ of the Nun Moth, *Liparis monarcha*, Linnæus, which year after year, stripping it of foliage, has often destroyed thousands of acres of planted forests in Germany and Russia (Schlich, *Manual of Forestry*, iv. 289, f. 149–151). The Norway Spruce, as this tree is always called in the United States, was introduced into this country toward the end of the eighteenth century, and during the last fifty years has been more generally planted in the eastern and northern states than any other coniferous tree. As an ornamental tree the European Spruce has much to recommend it in these regions; it is quickly and therefore cheaply raised in the nursery to a size suitable for permanent planting out; it is very hardy and grows with a rapidity which is surpassed by that of only a few other trees; it is not particular about soil and position, and young trees are shapely in habit and dark and rich in color. In America, however, at the end of twenty-five or thirty years the trees usually begin to lose vigor, their tops becoming thin and ragged, and it is only under specially favorable conditions and in the middle Atlantic states that the Norway Spruce retains its beauty here for more than fifty years. Except, therefore, as a nurse for slower growing and more valuable trees, the European Spruce has not proved successful as an ornamental tree in America, and its general introduction here has interfered with the cultivation of more permanent and valuable species.

[12] *Picea obovata*, Ledebour, *Fl. Alt.* iv. 201 (1833); *Ill. Fl. Ross.* v. 28, t. 499. — Link, *Linnæa*, xv. 518. — Trautvetter, *Middendorff Reise*, i. pt. ii. 170 (*Pl. Jen.*). — Trautvetter & Meyer, *Middendorff Reise*, i. pt. ii. 87 (*Fl. Ochot.*). — Maximowicz, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 261 (*Prim. Fl. Amur.*). — Regel, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, iv. No. 4, 136 (*Tent. Fl. Ussur.*); *Russ. Dendr.* ed. 2, pt. i. 34. — Teplouchoff, *Bull. Soc. Nat. Mosc.* xli. pt. ii. 244. — Masters, *Jour. Linn. Soc.* xviii. 506 (*Conifers of Japan*). — Herder, *Bot. Jahrb.* xiv. 160 (*Fl. Europ. Russlands*). — Miyabe, *Mem. Bost. Soc. Nat. Hist.* iv. 261 (*Fl. Kurile Islands*).

Pinus Abies, Pallas, *Fl. Ross.* i. 6, t. 1, f. G. (not Linnæus) (1784).

Abies obovata, Loudon, *Arb. Brit.* iv. 2329 (1838). — Maximowicz, *Bull. Phys. Math. Acad. Sci. St. Pétersbourg*, xv. 437 (*Bäume und Sträucher des Amurlands*).

Pinus obovata, Antoine, *Conif.* 96, t. 37, f. 2 (not Turczaninow) (1840–47). — Endlicher, *Syn. Conif.* 119. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 415.

Pinus orientalis, Ledebour, *Fl. Ross.* iii. 671 (in part) (not Linnæus) (1847–49).

Picea vulgaris, var. *Altaica*, Teplouchoff, *Bull. Soc. Nat. Mosc.* xli. pt. ii. 250 (1869).

Abies excelsa, K. Koch, *Dendr.* ii. pt. ii. 238 (in part) (not Lamarck) (1873).

Picea obovata is a lofty tree of the size and habit of *Picea Abies*, from which it differs chiefly in its short oval or oblong cylindrical cones, with rounded nearly entire scales, and is distributed from northeastern Russia through Siberia to Manchuria and northern China, ranging northward in Siberia, to latitude 69° 30′, and often forming vast forests on plains, and on the Altai Mountains, covering these from their foothills up to elevations of four thousand feet above the sea.

What is perhaps a form of the Siberian Spruce, with longer leaves and usually smaller cones, of the desert mountains of southwestern Siberia, is

Var. β *Schrenckiana*, Masters, *Jour. Linn. Soc.* xviii. 506 (*Conifers of Japan*) (1881).

Picea Schrenckiana, Fischer & Meyer, *Bull. Acad. Sci. St. Pétersbourg*, x. 253 (1842). — Carrière, *Traité Conif.* 254. — Beissner, *Handb. Nadelh.* 371.

Pinus Schrenckiana, Antoine, *l. c.* 97 (1840–47). — Endlicher, *l. c.* 120.

Pinus orientalis, β *longifolia*, Ledebour, *l. c.* (1847–49).

Abies Schrenckiana, Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 212 (1850). — Maximowicz, *Bull. Soc. Nat. Mosc.* liv. pt. i. 58.

Pinus obovata, β *Schrenckiana*, Parlatore, *l. c.* (1868). — Carrière, *Traité Conif.* ed. 2, 338.

? *Picea Tianschanica*, Ruprecht, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, xiv. No. 3, 72 (*Sertum Tianschanicum*) (1870).

Little is known of the Siberian Spruces in the gardens of the eastern United States and of western Europe. In Great Britain they grow badly and are often destroyed by spring frosts, while in New England, where they are now growing in the Arnold Arboretum, the oldest plants are still too young to give any idea of the value of these trees for our plantations.

The curious dwarf Spruce, *Picea Maximowiczii* (Masters, *Gard. Chron.* n. ser. xiii. 363 [1880]), with very slender acicular spine-tipped leaves spreading on all sides from the glabrous brown branchlets, and minute cones, which was raised from seeds distributed several years ago from the Imperial Botanic Garden of St. Petersburg and supposed to have come from Japan, and which has proved hardy in eastern Massachusetts, is perhaps an immature or transitory form of *Picea obovata*, from which, however, it differs in the position of the resin canals of the leaves, or of some still unknown species of continental Asia.

[13] Saporta, *Origine Paléontologique des Arbres*, 80.

[14] In North America more than fifty species of insects are reported to be living on the various species of Picea, although comparatively little is yet known of those which prey on these trees in the western part of the continent. In Europe Kaltenbach records between three and four hundred species injurious to coniferous trees, and a large proportion of these feed on the Spruces, which, however, are principally injured by only a few kinds. Although a great majority of the insects which obtain their food from Spruce-trees are not abundant enough to inflict serious damage on them, there are several kinds which are sometimes widely destructive. (See Packard, *5th Rep. U. S. Entomolog. Comm.* 811.)

The living trunks of Spruce-trees are not exempt from borers, belonging chiefly to the longicorn group, which also affect the true Pine-trees. Among such beetles are *Monohammus confusor*, Kirby, and *Monohammus dentator*, Fabricius, while *Rhagium lineatum*, Olivier, infests the dry timber. Larvæ of beetles belonging to the Buprestidæ also bore into the wood, both living and dead. The greatest damage to the trunk, however, appears to be caused by various species of several genera of small timber and bark beetles belonging to the family Scolytidæ. Among these, *Pityophthorus puberulus*, Leconte, *Xyloterus bivittatus*, Kirby, and *Xyleborus cœlatus*, Eichhoff, are said to be most destructive, and are credited with causing great damage to the Spruce forests in Maine, New Hampshire, and New York. *Polygraphus rufipennis*, Kirby, and *Dendroctonus frontalis*, Zimmerman, have been particularly destructive to the Red Spruce in northern New York and in West Virginia. (See Peck, *Trans. Albany Inst.* viii. 294. — Hopkins, *Bull.* No. 17, *West Virginia Agric. Exper. Stat.* 1891; *Insect Life*, iii. 1893, 187.)

Other species of beetles of the same group also attack both living and dead wood, *Dendroctonus rufipennis*, Kirby, being said to damage seriously the Red Spruce in New Hampshire and the Engelmann Spruce in Utah. *Hylesinus sericeus*, Mannheim, *Dryocœtes affaber*, Mannheim, and *Tomicus Pini*, Say, are common species, which bore into the trunks of Spruce-trees in the Rocky Mountain region.

Spruces are not affected by many species of foliage-destroying insects, and few of these are ever abundant enough to do much damage. Several of them, however, are liable to become very destructive.

A number of species of Saw-flies occur on Spruce-trees, their larvæ occasionally stripping the leaves from individual branches or from whole trees. The larvæ of various Noctuids and other Lepidoptera feed on Spruce-trees without attracting attention, although several species of Tortricidæ have proved serious enemies of their foliage. According to Packard, the Spruce-bud Worm, *Tortrix fumiferana*, Clemens, has at times been very destructive to Spruce-trees in Maine and in other Spruce producing regions. *Gelechia obliquistrigella*, Chambers, *Teras variana*, Fernald, and *Steganoptycha Ratzburgiana*, Saxesen, are small moths, whose larvæ feed on the foliage of Spruce-trees. Larvæ of the Spruce-cone Worm, *Pinipestis reniculella*, Grote, feed upon and burrow in the young cones, several of them being often partially inclosed in a silken web, more or less covered with castings from the mining caterpillars.

Plant lice, like *Lachnus Abietis*, Fitch, occur on Spruce-trees; and species of the so-called bud lice belonging to the genus Adelges, or Chermes, affect these trees, particularly in parks and gardens. *Adelges Abietis*, Linnæus, originally found on Spruces in Europe, is now also known in this country, and *Adelges abieticolens*, Thomas, has been described as an American species. These insects attack the young growing buds and shoots, eventually causing them to assume on the twigs hollow cone-like forms, within which the insects live during the summer, each apparent scale of this cone-like growth corresponding to the distorted base of a leaf. These abnormal growths are sometimes very abundant, causing much injury to the trees.

[15] Owing to the popular confusion in the nomenclature of the Spruces of the northeastern United States, which are vaguely termed Black, White, and Red, it is frequently difficult, if not impossible, to refer to different species of Picea, as now understood, the fungus parasites reported as infesting these trees. American

Spruce-trees appear to be much less subject to the attacks of fungi, however, than the European *Picea Abies*, on which more than two hundred species of fungi have been recorded. The Spruce Rust, *Peridermium abietinum*, Fries, of Europe, is very common, in the form called by Peck var. *decolorans*, on the dwarf Spruces which inhabit the subalpine summits of the mountains of the northeastern states, and its cluster-cups are so abundant toward the end of August in many places that those who walk through the dense dwarf Spruce forests are covered with their orange-colored spores. *Peridermium abietinum*, Fries, is considered in Europe to be connected with *Chrysomyxa Rhododendri*, De Candolle, but in northern Europe it has been supposed to be connected with *Chrysomyxa Ledi*, Albertini & Schweinitz. In northern New Hampshire the Peridermium on Spruce, judging by its range and habitat, is probably connected with *Chrysomyxa Ledi*, Albertini & Schweinitz, on *Ledum latifolium*, as no Chrysomyxa has been found on *Rhododendron Lapponicum* in that region. Besides the species mentioned, the fungi definitely reported on the Red Spruce, which are few in number, are principally Polypori, among which may be mentioned several varieties of *Polyporus volvatus*, Peck, and *Polyporus piceinus*, Peck, which attack the trunks of Spruce-trees, as does also the Ascomycete, *Colpoma morbidum*, Saccardo. Little is known of the fungal enemies of the Spruce-trees of western North America.

[2] The use sometimes of Picea and sometimes of Abies as the name of the Spruces still confuses the cultivators of these trees, although botanists now invariably call the Spruce-trees Picea and the Fir-trees Abies. Pliny and other classical writers possibly intended their Picea to designate the Fir-tree and their Abies the Spruce-tree, although Pliny's description of these two trees does not make this perfectly clear. In 1586 Camerarius (*De Plantis Epitome*, 47, f.), and in 1616 Dodoens (*Stirp. Hist.* 863, f.), used Picea as the name of the Spruce-tree and Abies as that of the Fir-tree. Tournefort, in 1719 (*Inst.* 585), united the Silver Firs and the Spruces, including the American Hemlock, in his genus Abies. Linnæus, in the first four editions of his *Genera Plantarum*, followed the arrangement of Tournefort, but in the fifth edition, published in 1754, he merged his genus Abies, including Picea, into Pinus, to which he also then referred Tournefort's genus Larix. In the first edition of the *Species Plantarum*, published in 1753, Linnæus called the European Spruce *Pinus Abies* and the European Fir *Pinus Picea*, following what was probably the classical application of the two names. Du Roi, in 1771 (*Harbk. Baums.* ii. 110), did the opposite, and called the Spruce Picea and the Fir Abies. In 1830 Link, separating the Spruces from the Pines and Firs, made the genus Picea for these trees, thus reversing Linnæus's use of Picea and Abies, and following that of Du Roi. (See *Abhand. Akad. Berl.* 1827, 179; *Linnæa*, xv. 516.) Endlicher, in 1836 (*Gen.* 260), followed Link in the use of Picea as the name of the Spruces, although he considered the group as a section of Pinus, and Carrière and all subsequent Continental authors have adopted the same nomenclature. In 1837, however, D. Don, in the third volume of Lambert's *Genus Pinus*, disregarding Link's application of the two names, called the Spruces Abies and the Firs Picea. Don's use of the two names was adopted by Loudon (*Arb. Brit.* iv. 2293), and later by Gordon, and has been in general use among English horticulturists ever since, although in the United States and in Continental Europe the Spruces are almost habitually called Picea and the Firs Abies. According to the rules of botanical nomenclature, this use is certainly correct without reference to the classical meaning of the two words, or to Linnæus's use of Picea and Abies as specific names in his genus Pinus, because Picea is the oldest name under which the Spruce-trees have been generically distinguished. (See Backhouse, *Gard. Chron.* n. ser. xxvi. 682, for a discussion of this subject.)

CONSPECTUS OF THE NORTH AMERICAN SPECIES.

- EUPICEA. Leaves tetragonal, stomatiferous on the four sides.
  - Cone-scales rounded at the apex.
    - Cone-scales stiff and ridged at maturity; branchlets pubescent.
      - Cones ovate on strongly incurved stalks, persistent for many years, their scales erose or dentate; leaves blue-green . . . . 1. P. MARIANA.
      - Cones ovate-oblong, short-stalked, early deciduous, their scales entire or obscurely denticulate; leaves dark yellow-green . . . . 2. P. RUBENS.
    - Cone-scales soft and flexible at maturity; branchlets glabrous.
      - Cones oblong-cylindrical, slender, their scales entire; leaves blue-green . . . . . 3. P. CANADENSIS.
  - Cone-scales usually oblong or rhomboidal; leaves blue-green.
    - Branchlets pubescent; leaves soft and flexible.
      - Cones oblong-cylindrical, or oval, their scales narrowed to a truncate or acute apex, or occasionally obovate and rounded, erose-dentate or entire . . . . 4. P. ENGELMANNI.
    - Branchlets glabrous; leaves rigid, spinescent.
      - Cones oblong-cylindrical, their scales rhomboidal, flexuose, rounded or truncate at the erose apex . . . . 5. P. PARRYANA.
- OMORIKA. Leaves flattened, usually stomatiferous only on the upper surface.
  - Cone-scales rounded, entire; branchlets pubescent.
    - Cones oblong-cylindrical, slender; leaves obtuse, stomatiferous only on the upper surface 6. P. BREWERIANA.
  - Cone-scales oblong-oval, rounded and denticulate above the middle; branchlets glabrous.
    - Cones cylindrical-oval; leaves acute or acuminate, stomatiferous on the upper and occasionally also on the lower surface . . . . 7. P. SITCHENSIS.

PICEA MARIANA.

Black Spruce.

CONES ovate, incurved at the base, persistent, their scales rounded, erose, or dentate. Branchlets pubescent. Leaves short, blue-green.

Picea Mariana, Britton, Sterns & Poggenburg, *Cat. Pl. N. Y.* 71 (1888). — J. G. Jack, *Garden and Forest*, x. 62.

Abies Mariana, Miller, *Dict.* ed. 8, No. 5 (1768). — Muenchhausen, *Hausv.* v. 224. — Wangenheim, *Nordam. Holz.* 75. — K. Koch, *Dendr.* ii. pt. ii. 240. — Lauche, *Deutsche Dendr.* ed. 2, 92.

Pinus Mariana, Du Roi, *Obs. Bot.* 38 (1771); *Harbk. Baumz.* ii. 127. — Moench, *Baume Weiss.* 74. — Burgsdorf, *Anleit.* pt. ii. 169. — Ehrhart, *Beitr.* iii. 23.

Pinus-Abies Canadensis, Marshall, *Arbust. Am.* 103 (1785).

Pinus nigra, Aiton, *Hort. Kew.* iii. 370 (1789). — Willdenow, *Berl. Baumz.* 220; *Spec.* iv. pt. i. 506; *Enum.* 990. — Borkhausen, *Handb. Forstbot.* i. 406. — Lambert, *Pinus*, i. 41, t. 27. — Persoon, *Syn.* ii. 579. — Bigelow, *Fl. Boston.* 234. — Pursh, *Fl. Am. Sept.* ii. 640. — Nuttall, *Gen.* ii. 223. — Hayne, *Dendr. Fl.* 177. — Sprengel, *Syst.* iii. 885. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 33. — Torrey, *Fl. N. Y.* ii. 230 (in part). — Hooker, *Fl. Bor.-Am.* ii. 163. — Antoine, *Conif.* 88, t. 34, f. 3. — Endlicher, *Syn. Conif.* 115. — Lawson & Son, *List No. 10, Abietineæ*, 16. — Dietrich, *Syn.* v. 395. — Courtin, *Fam. Conif.* 61. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 413.

Pinus Canadensis, β nigra, Castiglioni, *Viag. negli Stati Uniti*, ii. 315 (1790).

Pinus Americana, Gærtner, *Fruct.* ii. 60, t. 91 (not Du Roi) (1791).

Abies nigra, Du Roi, *Harbk. Baumz.* ed. 2, ii. 182 (1800). — Poiret, *Lamarck Dict.* vi. 520. — Desfontaines, *Hist. Arb.* ii. 580. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 475. — Michaux f. *Hist. Arb. Am.* i. 123 (in part). — *Nouveau Duhamel*, v. 292, t. 81, f. 1. — Jaume Saint-Hilaire, *Traité des Arbres Forestiers*, t. 74, f. 1-4. — Lindley, *Penny Cycl.* i. 32. — Rafinesque, *New Fl.* i. 39. — Lawson & Son, *Agric. Man.* 367. — Spach, *Hist. Vég.* xi. 410 (in part). — Emerson, *Trees Mass.* 81; ed. 2, i. 96. — Knight, *Syn. Conif.* 36. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 211. — Gordon, *Pinetum*, 11. — Darlington, *Fl. Cestr.* ed. 3, 292. — Henkel & Hochstetter, *Syn. Nadelh.* 191. — (Nelson) Senilis, *Pinaceæ*, 50. — Hoopes, *Evergreens*, 169. — Veitch, *Man. Conif.* 74. — Schübeler, *Virid. Norveg.* i. 431.

Abies denticulata, Michaux, *Fl. Bor.-Am.* ii. 206 (1803). — Poiret, *Lamarck Dict.* vi. 524. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 36.

Picea nigra, Link, *Handb.* ii. 478 (1831); *Linnæa*, xv. 520. — Carrière, *Traité Conif.* 241. — Brunet, *Hist. Picea*, 10, t. — Sénéclauze, *Conif.* 32. — Regel, *Russ. Dendr.* pt. i. 18. — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 85. — Peck, *Trans. Albany Inst.* viii. 283 (in part). — Engelmann, *Gard. Chron.* n. ser. xi. 334 (excl. var. *rubra*). — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 202 (in part). — Willkomm, *Forst. Fl.* ed. 2, 96. — Watson & Coulter, *Gray's Man.* ed. 6, 491. — Mayr, *Wald. Nordam.* 218. — Beissner, *Handb. Nadelh.* 332, f. 93, 94. — Masters, *Jour. R. Hort. Soc.* xiv. 222 (in part). — Hansen, *Jour. R. Hort. Soc.* xiv. 430 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 23, f. 8, L. — Rothrock, *Rep. Dept. Agric. Penn.* 1895, pt. ii. *Div. Forestry*, 282.

Picea nigra, α squamea, Provancher, *Flore Canadienne*, ii. 557 (1862).

Picea rubra, Britton, *Bull. Torrey Bot. Club*, xxi. 27 (not Dietrich) (1894). — Britton & Brown, *Ill. Fl.* i. 55 (in part), f. 123.

Picea brevifolia, var. semiprostrata, Peck, *Spruces of the Adirondacks*, 12 (1897).

Picea brevifolia, Peck, *Spruces of the Adirondacks*, 13 (1897). — Britton & Brown, *Ill. Fl.* iii. Appx. 496, f. 122 a.

A tree, usually twenty or thirty and occasionally one hundred feet in height, with a trunk from six to twelve inches and occasionally three feet in diameter, often small and stunted, frequently cone-bearing when only two or three feet high,[1] and at the extreme north reduced to a low semiprostrate shrub. The branches, which are slender, comparatively short, and usually pendulous with upward curves, form the open and irregular crown which is characteristic of the Black Spruce, and sometimes, when the tree has grown in a favorable position, clothe the stem to the ground, or soon fall from its lower half when the tree has been shaded by neighbors or stunted by insufficient nourishment.[1] The bark of the trunk is from one quarter to one half of an inch in thickness, and is broken on the surface into thin rather closely appressed gray-brown scales. The branchlets when they first emerge from the buds in early summer are pale green, and, like the bases of the leaves, are coated with pale pubescence; they soon begin to grow darker, and during their first autumn and winter they are light cinnamon-brown and covered with short rusty pubescence, their thin dark brown bark gradually becoming glabrous, and beginning to break up into small thin scales during their second year. The winter-buds are ovate, acute, light reddish brown, puberulous, and about one eighth of an inch in length, with ovate closely appressed acute scales. The leaves stand out from all sides of the branches, and are tetragonal, ribbed above and below, abruptly contracted at the apex into short slender callous tips, longer and more acute on sterile than on fertile branches, slightly incurved above the middle, pale blue-green when they first appear, bluish green and glaucous at maturity, from one quarter to three quarters of an inch in length, hoary on the upper surface from the broad bands of conspicuous stomata, and lustrous and slightly stomatiferous on the lower surface. The staminate flowers are subglobose and about an eighth of an inch in length, with dark red anthers, and the pistillate flowers are oblong-cylindrical, with obovate purple scales rounded above, wedge-shaped below, puberulous and tumid on the outer surface, and marked below the thin erose bright red margin by a conspicuous transverse glaucous band, and with oblong purple glaucous bracts rounded and denticulate at the apex. The cones increase rapidly in size, and are often almost fully grown in early summer before the young shoots have attained half their length; at maturity they are ovate, pointed, gradually narrowed at the base into short strongly incurved stalks clothed with the persistent enlarged erose inner scales of the flower-buds, which increase in size from the base to the apex of the stalk, and gradually assume the appearance of the small sterile lower cone-scales; usually about an inch long, the cones vary from one half of an inch to an inch and a half in length; their scales are rigid, rounded or rarely somewhat pointed at the apex, and puberulous, with delicate more or less erose or notched pale margins; in ripening the cones turn a dull gray-brown, and as the scales gradually open and slowly discharge their seeds they often become almost globose in form, and remain on the branches sometimes for twenty or thirty years, the oldest close to the bases of the branches near the trunk. The seeds are oblong, gradually narrowed to the acute base, about an eighth of an inch in length,

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[1] In northern Minnesota, on the borders of small forest lakes or muskeags, which are being gradually covered by sedges and sphagnum, the Black Spruce is able to exist without mineral soil, and to grow slowly to a great age on beds of floating plants. Such trees often produce cones when only two or three feet high; and as their energies appear to be entirely devoted to bearing seeds, the fertile branches become the only vigorous ones. "These are densely crowded near the top of the tree, while the trunk below is

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often destitute of living branches, although unshaded and growing far from other trees. These dense tufts of dark branches like plumes upon poles present a strange spectacle to the traveler who for the first time crosses the larger muskeags, especially at twilight, for he seems to be looking over a weird procession, stretching often mile after mile until lost in the distance." On the small muskeags there is often a regular gradation in the size of the trees, from little seedlings close to the water in the centre of the bog to tall slender specimens often sixty feet in height, with thin drooping branches which are freely developed on the better soil of the high margins, and trunks which rarely exceed eight inches in diameter. (See Ayres, *Garden and Forest*, vii. 504, f. 80 [*The Muskeag Spruce*]).

Cone-bearing Black Spruces not over two feet high are very abundant also in the sphagnum-covered bogs of Prince Edward's Island.

[1] "There seems to be four forms of the Black Spruce in northern Minnesota. First, the upland form with pendulous branches; second, the common upland form with stiff branches, the two grading one into the other; third, the dwarf tree with only fruiting branches and perhaps a few others at the base of the stem, growing on very wet muskeags; fourth, the stiff-branched tree, growing mostly on drier land than number three, although still on sphagnum and usually on the borders of the same muskeags. I can see no distinct lines of separation between these forms, which seem to grade into each other, that is, intermediate forms are found in complete series, and I am inclined to believe that the variation in the development of the branches is due to the conditions under which the trees are grown. Plants of the branchless form of the muskeags are of remarkably slow growth. One of these I cut, and counted seventy-five layers of annual growth in the stem, which was about an inch and a half in diameter. Such wood is very compact and even in texture. Occasionally one of the upland trees is cut for log timber, but they are never large, and I have not seen one above twelve inches in diameter." (Ayres, *in litt.*)

and very dark brown, with delicate pale brown lustrous wings broadest above the middle, very oblique at the apex, often nearly half an inch long and an eighth of an inch wide.

Picea Mariana inhabits sphagnum-covered bogs, and swamps and their borders, and at the north also well drained bottom-lands and the slopes of barren stony hills; it is distributed from the shores of Ungava Bay southwestward to those of Hudson Bay, and from the mouth of the Nelson River northwestward to the valley of the Mackenzie in about latitude 65° north,[1] and reappearing west of the Rocky Mountains on the interior plateau of British Columbia in latitude 53°,[2] it is common in the interior of Alaska as far north at least as the shores of Frances Lake and the valley of the Pelly River;[3] southward it ranges through Newfoundland, the Maritime Provinces, eastern Canada, and the northeastern United States to Pennsylvania, and along the Alleghany Mountains to northern Virginia;[4] it occurs on the eastern foothills of the Rocky Mountains in Alberta,[5] and extends through Assiniboia, northern Saskatchewan, and northern Manitoba to central Minnesota, Wisconsin, and Michigan. In the Labrador peninsula the Black Spruce is the most abundant tree, growing both in cold sphagnum swamps and on high hills covered with sands or with rocks or heavy glacial drift, usually in dense thickets, with long slender naked stems, but along the border of the treeless plains, where, alone with the Larch, the Black Spruce holds the northern outposts of the forest, it grows in open glades, and its stout trunks are clothed to the ground with branches.[6] West of Hudson Bay the Black Spruce also reaches the margin of the barren lands, forming scattered groves along the Telzoa River down to Doobaunt Lake, in latitude 63°, the most northern plants being here low shrubs with wide-spreading branches, from which occasionally a small upright stem rises to the height of four or five feet.[7] On the alluvial bottom-lands of the Athabasca River, between latitudes 58° and 59°, the Black Spruce is abundant, with trunks often three feet in diameter and occasionally eighty feet in height. It is the largest coniferous tree of Saskatchewan and of northwestern Manitoba, frequently covering large areas and growing both on well drained bottoms, where it attains its largest size, and on low stony hills, where it is small and stunted. The Black Spruce is common in Newfoundland, and in all the provinces of eastern Canada except in southern Ontario, growing in cold wet swamps and rarely attaining a greater height than thirty feet.[8] Farther south it is also almost exclusively an inhabitant of swamps and their borders, although occasionally a few stunted individuals maintain a foothold on the summits of the high hills of northern New England and New York. In the United States it is most common and grows to its largest size in the territory adjacent to the Great Lakes, where, however, it is nowhere abundant, thriving only in the moistest situations, and rarely producing trunks a foot in diameter. It is far less abundant than the Red Spruce in all the Appalachian region, and everywhere east of the Alleghany Mountains the Black Spruce is a small and comparatively rare tree, although it extends farther south along the Atlantic seaboard than any other Spruce, and occupies numerous small swamps near the coasts of southern New England, New York, New Jersey, and Pennsylvania.

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[1] Richardson, *Franklin Jour.* Appx. No. 7, 752; *Arctic Searching Exped.* ii. 317.

[2] *Picea Mariana* was collected by Dr. G. M. Dawson in 1876, east of the coast mountains of British Columbia, near the Blackwater River.

[3] See G. M. Dawson, *Rep. Geolog. Surv. Can.* n. ser. iii. pt. i. 112 B, 116 B, 118 B. — Macoun, *Rep. Geolog. Surv. Can.* n. ser. iii. pt. i. Appx. iii. 226 B.

[4] Britton & Brown, *Ill. Fl.* i. 55 (as *Picea rubra*).

[5] During the summer of 1897 *Picea Mariana* was found by Mr. John Macoun about thirty miles from Calgary, on one of the branches of the Elbow River.

[6] "The Black Spruce is the most abundant tree of the Labrador peninsula, constituting at least ninety per cent. of the forest, and it is found everywhere from the shores of the St. Lawrence northward to Ungava Bay, and from the Atlantic coast to Hudson Bay. The northern limit of its distribution, which coincides with that of the forest region, leaves the east coast of Hudson Bay in the neighborhood of latitude 57°, passes almost due east for about one hundred miles, until the watershed of Hudson Bay is crossed, when the course changes to nearly northeast, following the lower country of the Koksoak River, and reaches nearly to the shore of Ungava Bay, about fifteen miles north of the mouth of the Koksoak River, in about latitude 58° 30′ north. The trees skirt the southern shore of Ungava Bay to George River, at its southeastern corner, and grow from five to ten miles from the shore. From the mouth of George River, in latitude 58°, the line passes eastward for a short distance to the western flanks of the high Atlantic coast range, which here rises from three thousand to six thousand feet above the sea-level, and is quite barren. The Black Spruce is found in small open glades along the western flanks of the range, in the valleys of the streams and on the shores of lakes, southward to latitude 54°, where the groves become connected and a continuous forest covers the lower ground, while the hilltops remain bare for upwards of one hundred miles farther south.

"On the Atlantic coast the islands and mainland are without trees to below latitude 58°, where small Spruce and Larch are first found about watercourses, at the heads of the deep narrow fiords which penetrate far inland on this coast. At Davies Inlet, in latitude 56°, the trees are found growing everywhere along the coast, covering the lower hills, up to an elevation of five hundred feet, but the islands are still barren. At Hamilton Inlet, in latitude 54°, the trees ascend the hills to an elevation of nearly one thousand feet; and the inner islands are well wooded, only those far out from shore remaining barren." (Low *in litt.* See, also, Low, *Rep. Geolog. Surv. Can.* n. ser. viii. 35 L.)

[7] Tyrrell, *Rep. Geolog. Surv. Can.* n. ser. ix. 214 F.

[8] Brunet, *Cat. Vég. Lig. Can.* 58 (in part). — Macoun, *Cat. Can. Pl.* 468 (in part).

The wood of *Picea Mariana* is light, soft, and not strong; it is pale yellow-white, with thin sapwood, and contains thin resinous bands of small summer cells and narrow conspicuous medullary rays. The specific gravity of the absolutely dry wood is 0.5272, a cubic foot weighing 32.86 pounds. It is probably rarely used, except in Manitoba and Saskatchewan, for other purposes than the manufacture of paper pulp. Spruce gum, the resinous exudations of the Black and Red Spruces, and occasionally of the White Spruce, is gathered in considerable quantities, principally in northern New England and Canada, and is used as a masticatory.[1] Spruce beer is made by boiling the branches of the Black and Red Spruces.[2]

Picea Mariana was introduced by Bishop Compton, into his garden near London, before the beginning of the eighteenth century,[3] although the earliest description of it was not published until 1755.[4] Still frequently cultivated in western Europe,[5] and occasionally in the northern United States, the Black Spruce is one of the least desirable of all Spruce-trees for the decoration of parks and gardens, soon losing in cultivation the shapely habit and the vigorous beauty of its youth, which are replaced by a naked stem and a small open head of short straggling branches. In European nurseries a few abnormal forms of dwarf habit, or with pendulous branches, or with yellow or white leaves, are occasionally propagated.[6]

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[1] The resinous exudations of the Spruce-trees of eastern North America are obtained from the cavities of decayed knots and other natural depressions extending to the heartwood in the trunks of these trees, and not from wounds made for the purpose. The gum is collected in winter by "gummers," men on snow-shoes, carrying long poles armed with chisels, with which the resinous masses are knocked or cut off and caught in small cups attached to the poles just below the chisels. (See Menges, *Contrib. Dep. Pharm. University of Wisconsin*, No. 2, 30; *Am. Jour. Pharm.* lviii. 394. — Bastin & Trimble, *Am. Jour. Pharm.* lxviii. 413.)

A tincture prepared by dissolving the resinous gum of the eastern Spruce-trees in alcohol is occasionally used in medicine, although it has no official recognition in the Pharmacopœias. (See Millspaugh, *Am. Med. Pl. in Homœopathic Remedies*, ii. 163.)

[2] The preparation of a fermented beverage made by boiling Spruce branches with honey was probably familiar to the northern Indians before the settlement of the country by Europeans, who learned the art from them; and in 1672 the value of Spruce beer was recognized by Josselyn, who thus describes its virtues: —

"The tops of Green *Spruce* Boughs boiled in *Bear*, and drunk, is assuredly one of the best Remedies for the Scurvy, restoring the Infected party in a short time; they also make a Lotion of some of the decoction, adding Hony and Allum." (*New England's Rarities*, 64.)

Spruce beer, which is considered a pleasant and agreeable drink in hot weather, and a useful preventive of scurvy, is now made from the essence of spruce, which is a liquid of the color and consistency of molasses, with a bitter astringent acid flavor, obtained by boiling the young branches of the Black and Red Spruces in water and evaporating the decoction, the disagreeable odor of the White Spruce making it unsuitable for this purpose. To prepare this beverage the essence of spruce is boiled in water flavored with various ingredients, and is then mixed with molasses or occasionally with sugar, allowed to ferment, and bottled. (See Duhamel, *Traité des Arbres*, i. 17. — Rafinesque, *Med. Fl.* ii. 183. — Spons, *Encyclopædia of the Industrial Arts, Manufactures, and Raw Commercial Products*, i. 424. — *Druggists' Circular*, New York, 1880, 120. — *Mineral Water Review*, 1881, 140. — *U. S. Dispens.* ed. 16, 1487.

[3] Aiton, *Hort. Kew.* iii. 370. — Loudon, *Arb. Brit.* iv. 2312, f. 2225–2227.

[4] *Abies picea, foliis brevioribus, conis parvis biuncialibus laxis*, Duhamel, *l. c.* i. 3.

Abies Picea foliis brevioribus, Conis biuncialibus laxis, Miller, *Dict. Icon.* i. 1, t. 1.

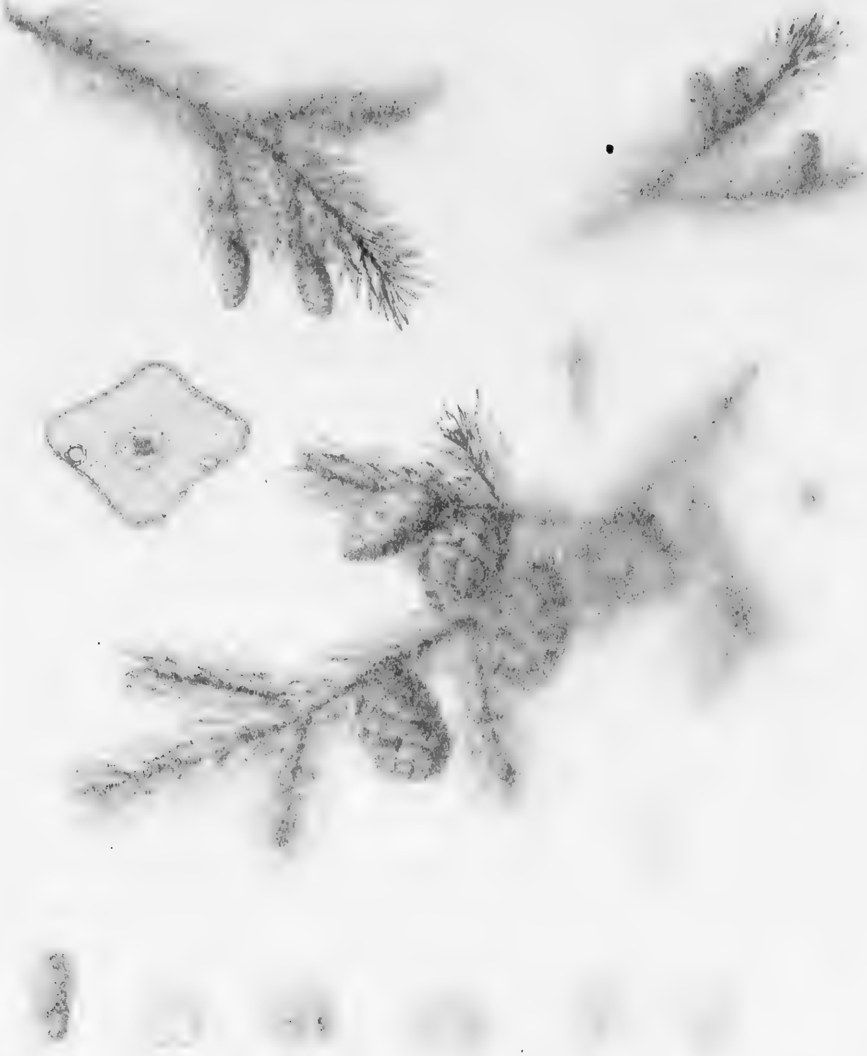
[5] In Great Britain the Black Spruce appears to be more commonly cultivated than any other conifer of eastern North America, with the exception of the White Pine, and, judging from numerous specimens which have been sent to me from England and Scotland, it does duty in Europe as the Black, Red, and White Spruces.

[6] The most distinct of the garden forms of the Black Spruce, at least in its young state, is the variety *Doumetii;* this is a dwarf plant, with short crowded branches, forming a narrow and very compact pyramidal head, and with crowded leaves, which was first noticed about 1835 in the garden of the Château de Balène, near Moulins, in France, and was described by Carrière in the *Traité Conif.* 242, as *Picea nigra Doumetii.* (For other abnormal forms of the Black Spruce, see Beissner, *Handb. Nadelh.* 337. See, also, *Gard. Chron.* ser. 3, xi. 81, t., for a description of a remarkably compact pyramidal form of the Black Spruce cultivated in the Wilhelmshöhe Park and in the Karlsane Park in Cassel.)

EXPLANATION OF THE PLATE.

PLATE DXCVI. PICEA MARIANA.

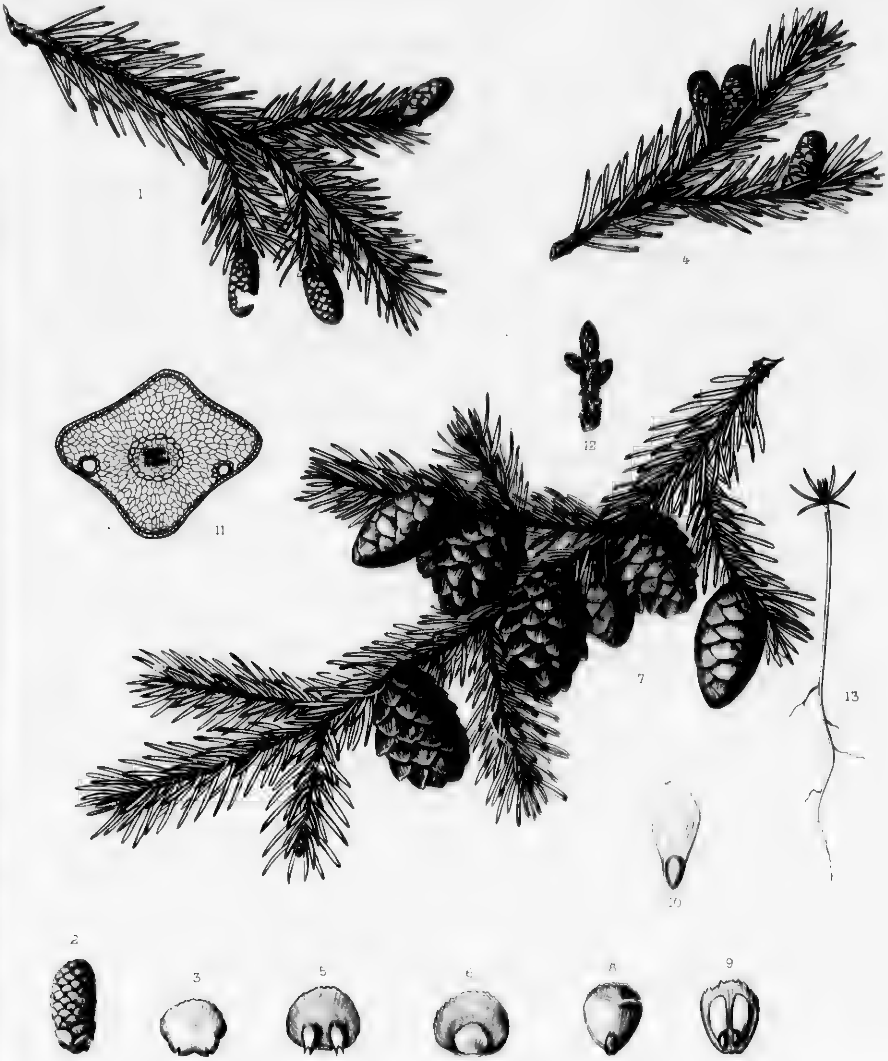
1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. A branch with pistillate flowers, natural size.
5. A scale of a pistillate flower, upper side, with its ovules, enlarged.
6. A scale of a pistillate flower, lower side, with its bract, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. A seed-wing, the seed removed, enlarged.
11. Cross section of a leaf magnified fifteen diameters.
12. Winter-buds, natural size.
13. A seedling plant, natural size.



[illegible] THE PLATE

[illegible] VI. Picea Mariana.

1. [illegible] flowers [illegible]
2. [illegible] enlarged.
3. [illegible] view, enlarged.
4. [illegible]
5. A scale of a pistillate flower [illegible] ovules, enlarged.
6. A scale of a pistillate flower [illegible] its bract, enlarged.
7. A fruiting branch, [illegible]
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. A seed-wing, the seed removed, enlarged.
11. Cross section of a leaf, magnified [illegible] diameters.
12. Winter buds, [illegible]
13. A seedling plant, [illegible]



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PICEA MARIANA [illegible]

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PICEA RUBENS.

Red Spruce.

Cones ovate-oblong, early deciduous, their scales rounded, entire, or obscurely denticulate. Branchlets pubescent. Leaves dark yellow-green.

Picea rubens.

? Pinus Abies acutissima, Muenchhausen, *Hausv.* v. 225 (1770).

Pinus Mariana rubra, Du Roi, *Obs. Bot.* 39 (1771); *Harbk. Baumz.* ii. 129.

Pinus Americana rubra, Wangenheim, *Nordam. Holz.* 75, t. 16, f. 54 (not *Pinus rubra*, Miller) (1787).

Pinus rubra, Lambert, *Pinus*, i. 43, t. 28 (not Miller) (1803). — Willdenow, *Spec.* iv. pt. ii. 507. — Persoon, *Syn.* ii. 579. — Aiton, *Hort. Kew.* ed. 2, v. 319. — Pursh, *Fl. Am. Sept.* ii. 640. — Nuttall, *Gen.* ii. 223. — Sprengel, *Syst.* iii. 885. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 33. — Hooker, *Fl. Bor-Am.* ii. 164. — Antoine, *Conif.* 87, t. 34, f. 2. — Endlicher, *Syn. Conif.* 113. — Gihoul, *Arb. Rés.* 44. — Lawson & Son, *List No. 10, Abietineæ*, 18. — Dietrich, *Syn.* v. 394. — Courtin, *Fam. Conif.* 64. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 413.

Abies rubra, Poiret, *Lamarck Dict.* vi. 520 (1804). — Desfontaines, *Hist. Arb.* ii. 580. — Rafinesque, *New Fl.* i. 39. — Lawson & Son, *Agric. Man.* 368. — Loudon, *Arb. Brit.* iv. 2316, f. 2228. — Forbes, *Pinetum Woburn.* 101, t. 35. — Knight, *Syn. Conif.* 37. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 211. — Gordon, *Pinetum*, 11. — Henkel & Hochstetter, *Syn. Nadelh.* 189. — (Nelson) Senilis, *Pinaceæ*, 51. — Lauche, *Deutsche Dendr.* ed. 2, 92. — Schübeler, *Virid. Norveg.* i. 435.

Abies nigra, Michaux f. *Hist. Arb. Am.* i. 123 (in part), t. 11 (not Du Roi) (1810). — Gray, *Man.* 441 (in part). — Chapman, *Fl.* 434. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 27.

Pinus nigra, Elliott, *Sk.* ii. 640 (not Aiton) (1824). — Torrey, *Fl. N. Y.* ii. 230 (in part).

Pinus alba, Elliott, *Sk.* ii. 640 (not Aiton) (1824).

Picea rubra, Dietrich, *Fl. Berl.* ii. 795 (1824). — Link, *Handb.* ii. 478; *Linnæa*, xv. 521. — Carrière, *Traité Conif.* 240. — Sénéclauze, *Conif.* 34. — Regel, *Russ. Dendr.* pt. i. 19. — Willkomm, *Forst. Fl.* ed. 2, 96. — Beissner, *Handb. Nadelh.* 338, f. 95. — Hansen, *Jour. R. Hort. Soc.* xiv. 437 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 23.

Abies alba, Jaume St. Hilaire, *Traité des Arbres Forestiers*, t. 74, f. 7–9 (not Michaux) (1824).

Abies nigra, β **rubra**, Spach, *Hist. Vég.* xi. 411 (1842). — Hoopes, *Evergreens*, 170.

Abies alba, Chapman, *Fl.* 435 (not Poiret) (1860). — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 27.

Picea nigra, Provancher, *Flore Canadienne*, ii. 557 (excl. var. *a squamea*) (not Link) (1862). — Peck, *Trans. Albany Inst.* viii. 283 (in part). — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 202 (in part). — Masters, *Jour. R. Hort. Soc.* xiv. 232 (in part). — Fox, *Rep. Forest Comm. N. Y.*, 1894, 121, t.

Picea nigra, var. **grisea**, Brunet, *Cat. Vég. Lig. Can.* 59 (1867).

Abies Americana, K. Koch, *Dendr.* ii. pt. ii. 241 (not Miller nor Du Mont de Courset) (1873).

Picea nigra, var. **rubra**, Engelmann, *Gard. Chron.* n. ser. xi. 334 (1879). — Watson & Coulter, *Gray's Man.* ed. 6, 492. — Rothrock, *Rep. Dept. Agric. Penn.* 1895, pt. ii. *Div. Forestry*, 281.

Picea Mariana, Britton, *Bull. Torrey Bot. Club*, xxi. 27 (not Britton, Sterns & Poggenburg) (1894). — Britton & Brown, *Ill. Fl.* i. 55 (in part), f. 122.

Picea acutissima, J. G. Jack, *Garden and Forest*, x. 63 (1897).

A tree, usually seventy or eighty and occasionally from one hundred to one hundred and ten feet in height, with a trunk from two to three feet in diameter,[1] and slender spreading branches which, with abundant light and air, continue to clothe the stem to the ground, forming a narrow and rather formal conical head, or which soon perish on trees crowded in the forest, leaving the trunks naked for at least two thirds of their length, and at the timber-line of high mountains often reduced to a low semiprostrate shrub.[2] The bark of the trunk is from one quarter to nearly one half of an inch in thickness, and is broken into thin closely appressed irregularly shaped red-brown scales. The branchlets, which are comparatively stout, are light green and covered with pale pubescence when they emerge from the buds, and during their first autumn and winter are bright reddish brown or orange-brown in color and clothed with rusty brown pubescence; growing gradually darker during succeeding seasons, their bark loses its pubescent covering, and when they are three or four years old it begins to separate into thin scales. The winter-buds, which vary in size from one quarter to one third of an inch in length, are ovate and acute, with light reddish brown closely appressed acute scales, and are often surrounded by the elongated acicular scale-like upper leaves, which easily separate from their prominent persistent bases. The leaves stand out from all sides of the branch, pointing forward, and are more or less incurved above the middle; they are tetragonal, acute or rounded and tipped at the apex with a short callous mucro, pale bluish green when they first appear, dark green often slightly tinged with yellow and very lustrous at maturity, marked on the upper surface with four rows of stomata on each side of the prominent midrib and on the lower surface less conspicuously with two rows on each side of the midrib, from one half to five eighths of an inch long and nearly one sixteenth of an inch wide. The staminate flowers are oval, almost sessile, half an inch long and a quarter of an inch thick, with bright red conspicuously toothed anther-crests. The pistillate flowers are oblong-cylindrical and about three quarters of an inch in length, with rounded scales thin, reflexed and slightly erose on the margins, and obovate bracts rounded and laciniate above. The cones are ovate-oblong and gradually narrowed from near the middle to the acute apex, with concave rigid striate obovate-oblong scales rounded above and entire or slightly toothed on their thin and often flexuose edges; they are usually from an inch and a quarter to two inches long, but vary from an inch to two and a half inches in length, and are borne on very short straight or incurved stalks; when fully grown they are light green or green somewhat tinged with purple, but at maturity are light reddish brown and lustrous, and, beginning to fall as soon as the scales open late in the autumn or during the early winter, generally all disappear from the branches the following summer. The seeds are very dark brown and about an eighth of an inch long, with short broad wings full and rounded above the middle.

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[1] A Red Spruce tree near Meecham Lake, as reported by Mr. Fremont Fuller of Duane, Franklin County, New York, to the Secretary of the Forest Commission of that state, has a trunk circumference of ten feet three inches at four feet above the ground. This is the largest trunk of this species of which I have heard.

[2] In 1892 Mr. George Walker of Williamstown, Massachusetts, found near the base of Mt. Hopkins and about three miles from

The Red Spruce is distributed from the valley of the St. Lawrence River[1] and the northern shores of Prince Edward Island southward through Quebec, the Maritime Provinces, and along the Atlantic coast to southern Maine[2] and Cape Ann, Massachusetts,[3] and through the hilly interior and the mountainous parts of New England and New York and along the Alleghany Mountains to the high peaks of western North Carolina. Comparatively rare and of small size north of the boundary of the United States and in the neighborhood of the coast, the Red Spruce, which is an inhabitant of high well drained gravelly slopes, is most abundant and attains its greatest dimensions in the elevated regions of northern New England and New York, where, mingled with the Hemlock, the White Pine and the Balsam Fir, the Larch, the Sugar Maple, the Yellow Birch and the Beech, it grows singly or in small dense groves, often forming a large proportion of the forest. On the uplands of Massachusetts, especially on the Berkshire hills, and on the mountains which overlook the Hudson, it is not rare; it is common on the mountains of southern New York and northern New Jersey, and is widely scattered over the Alleghany Mountains in Pennsylvania, often forming a considerable part of the

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the northwest corner of the state of Massachusetts a plant of *Picea rubens* with naked snake-like branches, similar in habit to some of the monstrous forms of the European *Picea Abies*. A portrait of this plant, which is the only example recorded of such a departure from normal forms among the American Spruces, was published on page 45 of the eighth volume of *Garden and Forest*. Young plants raised by grafts from the Williamstown plant are now growing in the Arnold Arboretum.

[1] *Picea rubens* was found in 1895 by Mr. J. G. Jack at St. Catharines on the St. John's Railroad in Quebec. This is the most northern station from which this tree has been reported. It appears to be common on the slopes of the Laurentian hills in the St. Lawrence valley west of the Saguenay, as far west at least as the city of Ottawa. I have no evidence beyond Lambert's statement that the Red Spruce grows in Newfoundland.

[2] The Red Spruce is abundant on Gerrish Island off the mouth of the Piscataqua River, Maine.

[3] In June, 1896, Mr. J. H. Sears found *Picea rubens* growing singly and in small clumps over an area of about fifty acres near the town of Rockport, Massachusetts.

forests which clothe their high slopes.[1] It is also widely distributed over the mountains of West Virginia, forming on the head-waters of the Elk and Gauley Rivers a broad belt through which it is scattered often abundantly, sometimes occupying almost exclusively the high slopes, particularly those which face the north, and the summits of the mountains; farther south it is small and less abundant, and at the southern limits of its range it is usually only forty or fifty feet in height and confined to the high mountains, where, occasionally forming pure forests, it usually grows in small groves near their summits with the Balsam Fir and the Yellow Birch, and rarely below elevations of five thousand feet above the sea-level.

Picea rubens, which is the principal timber Spruce of the northeastern United States, and, with the exception of the White Pine, the most valuable coniferous timber-tree of the region that it inhabits, produces light soft close-grained wood which is not strong, nor durable when exposed to the weather; it is pale slightly tinged with red, with paler sapwood about two inches thick, and a satiny surface, and contains remote conspicuous medullary rays, few resin passages, and thin resinous bands of small summer cells. The specific gravity of the absolutely dry wood is 0.4516, a cubic foot weighing 28.13 pounds. Now that the most valuable white pine has been exhausted in the forests of the northeastern states, the Red Spruce is their most important timber-tree, and immense quantities of its lumber are manufactured every year from trees cut in Maine, New Hampshire, Vermont, and northern New York, which supply the largest part of the Red Spruce logs, although red spruce is also manufactured in Pennsylvania and West Virginia. It is used largely for the flooring of houses and for joists, scantlings, and other square timbers employed in construction; it is considered the most valuable wood produced in the United States for the sounding-boards of musical instruments, and it is one of the principal woods used in this country in the production of paper pulp. Like those obtained from the Black Spruce, the resinous exudations of the Red Spruce are used for chewing-gum, and from its branches Spruce beer is made.

The first real description of the Red Spruce, with an excellent figure, was published by Lambert; it had been prepared from a tree cultivated in England which was supposed to have been brought from Newfoundland. It was the Red Spruce, no doubt, brought down to the coast from the forests of Maine, which attracted the attention of Josselyn by its great size and its value for shipbuilding.[2]

Confounded for many years with *Picea Mariana*,[3] little attention has been paid to the Red Spruce as an ornament of northern parks and gardens, where, although it grows more slowly than most coniferous trees,[1] its great value is shown by the old specimens densely clothed with branches which are occasionally seen near farmhouses in the northern states.[2]

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[1] In the Mehoopany Creek basin in Wyoming County in the northeastern part of Pennsylvania the Red Spruce is abundant between elevations of one thousand five hundred and two thousand two hundred feet above the sea, growing with the Sugar Maple, the Beech, the Yellow Birch, and the Hemlock. Before its destruction to feed pulp-mills it grew in large quantities and in great perfection in Bear Meadows, Centre County, and it appears to be generally scattered at high elevations along the whole of the Alleghany range in Pennsylvania.

[2] "*Spruce* is a goodly Tree, of which they make Masts for Ships, and Sail Yards: It is generally conceived by those that have skill in Building of Ships, that here is absolutely the best Trees in the World, many of them being three Fathom about, and of great length." (Josselyn, *New England's Rarities*, 63.)

"At *Pascataway* there is now a Spruce-tree, brought down to the water-side by our Mass-men, of an incredible bigness, and so long that no Skipper durst ever yet adventure to ship it, but there it lyes and Rots." (Josselyn, *An Account of Two Voyages to New England*, 67.)

[3] Lambert, who first distinguished the Red Spruce intelligently, clearly understood the characters of the Spruces of eastern North America, and the figures in his *Description of the Genus Pinus* admirably show the distinctive characters of the three species, and have never been surpassed. Until recent years, however, the botanists who have written of these trees since Lambert have copied his descriptions, or have united the Red and the Black Spruces, or have considered the former a variety of the latter. The confusion with regard to these two trees dates from the time of the Michauxs. The elder saw in the northern states only Black and White Spruces, and the son makes his description of the Black Spruce include the Red Spruce, which he considered merely a form due to soil conditions, his figure of the Black Spruce being taken from a branch of the Red Spruce. Nuttall, in his *Genera of North American Plants*, and Pursh, in his *Flora Americæ Septentrionalis*, retained Lambert's names, but evidently had little information about these trees, and Gray, in the early editions of the *Manual of Botany of the Northern States*, ignored the Red Spruce entirely, and in the fourth edition spoke of it as a northern form of the Black Spruce.

The Red Spruce does not appear ever to have been common or to have flourished very often in European plantations, and the European writers on conifers, down to the time of Beissner, who have described this tree at all, have been obliged for want of material to follow Lambert or Michaux. Mr. William Gorrie, however (*Trans. Bot. Soc. Edinburgh*, x. 353), has well described the Red Spruce from trees which had been planted about 185[illegible] near Tynehead in Midlothian, Scotland, and which, fifteen years later, were from twelve to eighteen feet high and had produced cones.

The two species are well distinguished by the size and shape of the staminate flowers, and by the size and shape of the cones, which on the Black Spruce are strongly hooked at the base and are persistent for many years, while on the Red Spruce they are usually much larger, with nearly straight much shorter stems, and fall mostly during their first winter. The leaves of the Red Spruce are long, dark green, and lustrous, and those of the Black Spruce are shorter and blue. Forms intermediate in character between the Black and Red Spruces are not known to exist. The Black Spruce, except at the far north, inhabits only wet sphagnum-covered bogs, while the Red Spruce grows only on well-drained hillsides. The Black Spruce is a tree of the far north, only existing precariously south of the northern border of the United States, while the Red Spruce is an Appalachian tree, attaining its greatest dimensions between northern New Hampshire and Pennsylvania. The distinctive characters of the two species have been well pointed out by George Lawson (*Researches on the Distinctive Characters of the Canadian Spruces*, 9. See, also, *Canadian Researches of Science*, vi. 172), and by J. G. Jack (*Garden and Forest*, x. 63). Fruiting branches of the two species are well figured by Beissner.

The first specific name of the Red Spruce is that of Lambert, *Pinus rubra*, published in 1803. *Pinus rubra*, however, in 1803, was a synonym, as it had been used in 1768 by Miller for another tree. For the same reason the varietal name *rubra*, used by Du Roi in 1771, and by Wangenheim in 1787, is not available. The impossibility of identifying Muenchhausen's *Pinus Abies acutissima*, published in 1770, under which he quotes as a synonym Plukenet's *Abies minor pectinatis foliis*, which is shown by Plukenet's figure to be the Hemlock Spruce, makes the use of Muenchhausen's varietal name also inadmissible. No other specific or varietal name having been used by earlier authors for the Red Spruce, I propose to call it *Picea rubens*.

[1] The Red Spruce grows very slowly and probably attains a greater average age than any other tree in the forests of the northeastern states. From a number of measurements made in the Adirondack region under the direction of Mr. William F. Fox, Superintendent of the State Forests of New York, it is shown that the Red Spruce, which in this report is called *Picea nigra*, may require three hundred and fifty-four years to produce a trunk only twenty-six inches in diameter on the stump. Of two hundred and thirty-seven trees examined in St. Lawrence County, twenty-four, with a maximum diameter of thirty inches, were from three hundred to three hundred and fifty-four years of age, while one hundred others were between two hundred and fifty and three hundred years old (Fox, *Rep. Forest Comm. N. Y.* 1894, 134).

[2] As an ornamental tree *Picea rubens* can be compared with *Picea orientalis*, which it resembles in its narrow pyramidal form and dense habit and in the rich dark coloring of its foliage. The White Spruce grows much more rapidly and is of a more open habit and livelier color than the Red Spruce, but it shows its highest beauty and grows to a great age only in regions of shorter summers and colder winters than southern New England, where the Red Spruce, finding the climatic conditions which suit it, should prove the most valuable of the American Spruces in ornamental plantations.

EXPLANATION OF THE PLATE.

Plate DXCVII. Picea rubens.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. A branch with pistillate flowers, natural size.
5. A pistillate flower, enlarged.
6. A scale of a pistillate flower, lower side, with its bract, enlarged.
7. A scale of a pistillate flower, upper side, with its ovules, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. A cone-scale, lower side, with its bract, natural size.
11. A seed, enlarged.
12. Cross section of a leaf, magnified fifteen diameters.
13. Winter-buds, natural size.
14. Winter-buds, showing leaf-like scales at their base, natural size.
15. A seedling plant, natural size.

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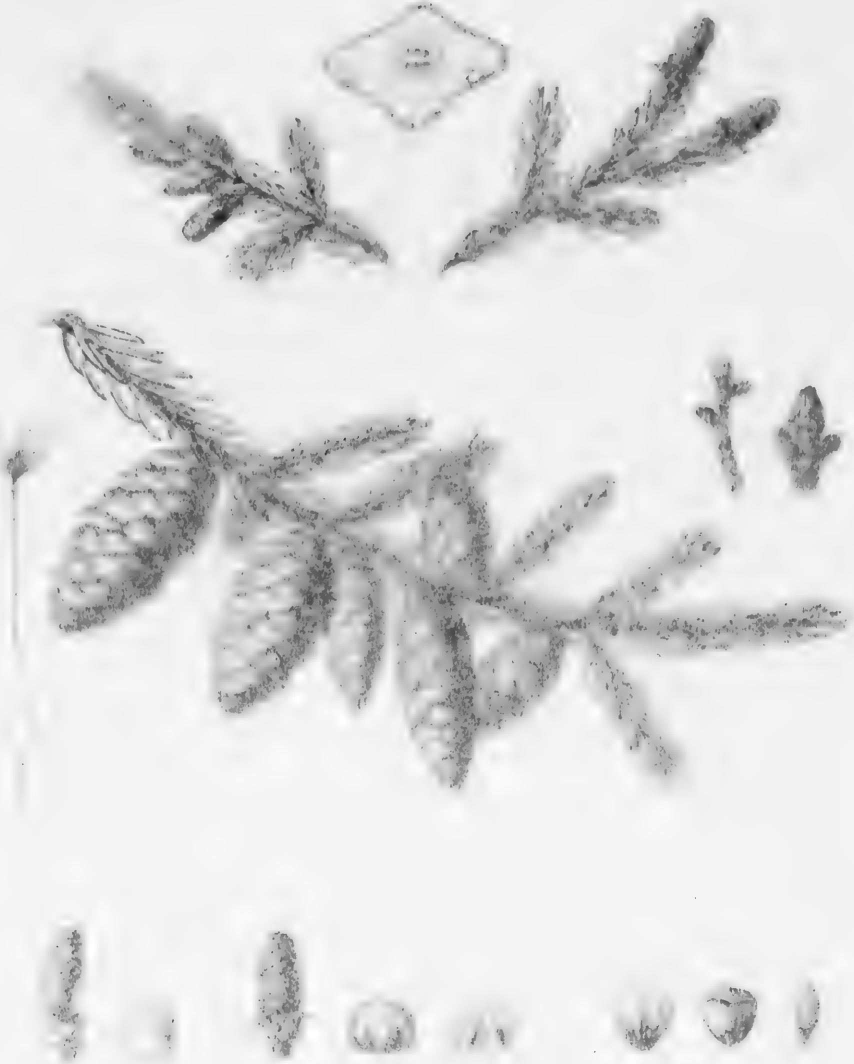

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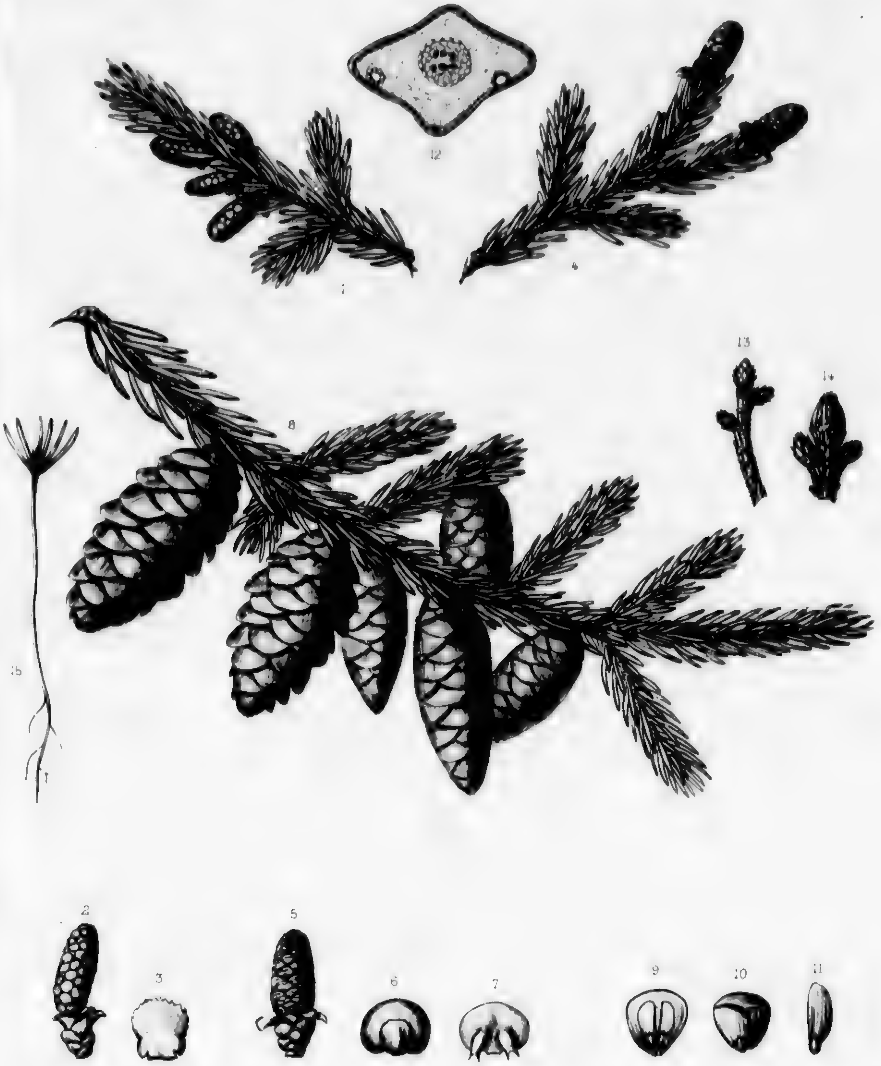

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PICEA CANADENSIS.

White Spruce.

Cones oblong-cylindrical, slender, their scales rounded, entire. Branchlets glabrous. Leaves blue-green, strong-smelling.

Picea Canadensis, Britton, Sterns & Poggenburg, *Cat. Pl. N. Y.* 71 (1888). — Sudworth, *Rep. Sec. Agric. U. S.* 1892, 329. — Britton & Brown, *Ill. Fl.* i. 54, f. 121.

Abies Canadensis, Miller, *Dict.* ed. 8, No. 4 (1768).

Pinus Abies laxa, Muenchhausen, *Hausv.* v. 225 (1770).

Pinus Canadensis, Du Roi, *Obs. Bot.* 38 (not Linnæus) (1771); *Harbk. Baumz.* ii. 124. — Burgsdorf, *Anleit.* pt. ii. 168. — Wangenheim, *Nordam. Holz.* 5, t. 1, f. 2.

Pinus laxa, Ehrhart, *Beitr.* iii. 24 (1788).

Pinus alba, Aiton, *Hort. Kew.* iii. 371 (1789). — Willdenow, *Berl. Baumz.* 221; *Spec.* iv. pt. i. 507. — Borkhausen, *Handb. Forstbot.* i. 402. — Lambert, *Pinus*, i. 39, t. 26. — Persoon, *Syn.* ii. 579. — Stokes, *Bot. Mat. Med.* iv. 425. — Pursh, *Fl. Am. Sept.* ii. 641. — Nuttall, *Gen.* ii. 223. — Hayne, *Dendr. Fl.* 177. — Guimpel, Otto & Hayne, *Abbild. Holz.* 156, t. 131. — Sprengel, *Syst.* iii. 885. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 34. — Meyer, *Pl. Labrador.* 30. — Hooker, *Fl. Bor.-Am.* ii. 163. — Torrey, *Fl. N. Y.* ii. 231. — Bigelow, *Fl. Boston.* ed. 3, 386. — Antoine, *Conif.* 86, t. 34, f. 1. — Endlicher, *Syn. Conif.* 112. — Lawson & Son, *List No. 10, Abietineæ*, 15. — Courtin, *Fam. Conif.* 60. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 414.

Pinus Americana, *a* **alba**, Castiglioni, *Viag. negli Stati Uniti*, ii. 314 (1790).

Pinus tetragona, Moench, *Meth.* 364 (1794).

Abies Americana, Du Mont de Courset, *Bot. Cult.* iii. 775 (not Miller) (1802).

Abies alba, Michaux, *Fl. Bor.-Am.* ii. 207 (not Miller) (1803). — Poiret, *Lamarck Dict.* vi. 521. — Desfontaines, *Hist. Arb.* ii. 580. — Michaux, f. *Hist. Arb. Am.* i. 133, t. 12. — *Nouveau Duhamel*, v. 291, t. 81, f. 2. — Rafinesque, *New Fl.* i. 39. — Lindley, *Penny Cycl.* i. 31. — Forbes, *Pinetum Woburn.* 95, t. 33. — Nuttall, *Sylva*, iii. 129. — Spach, *Hist. Vég.* xi. 412. — Emerson, *Trees Mass.* 84; ed. 2, i. 99. — Gihoul, *Arb. Rés.* 43. — Knight, *Syn. Conif.* 36. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 211. — Darlington, *Fl. Cestr.* ed. 3, 292. — Gordon, *Pinetum*, 9. — Henkel & Hochstetter, *Syn. Nadelh.* 188. — (Nelson) Senilis, *Pinaceæ*, 47. — Gray, *Man.* ed. 5, 471. — A. Murray, *Jour. Bot.* v. t. 69, f. 2–7. — Hoopes, *Evergreens*, 157, f. 20. — Nördlinger, *Forstbot.* 442, f. — Lauche, *Deutsche Dendr.* ed. 2, 93. — Schübeler, *Virid. Norveg.* i. 427.

Abies curvifolia, Salisbury, *Trans. Linn. Soc.* viii. 314 (1807).

Abies rubra, Jaume St. Hilaire, *Traité des Arbres Forestiers*, t. 78, f. 7–10 (not Poiret) (1824).

Picea alba, Link, *Handb.* ii. 478 (1831); *Linnæa*, xv. 519. — Carrière, *Traité Conif.* 238. — Van Houtte, *Fl. des Serres*, xxi. 157, t. 2251. — Brunet, *Hist. Picea*, 4, t. — Sénéclauze, *Conif.* 22. — Regel, *Russ. Dendr.* pt. i. 19. — Engelmann, *Gard. Chron.* n. ser. xi. 334. — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 85. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 204. — Willkomm, *Forst. Fl.* ed. 2, 97. — Watson & Coulter, *Gray's Man.* ed. 6, 492. — Mayr, *Wald. Nordam.* 219, f. 6. — Beissner, *Handb. Nadelh.* 340, f. 96. — Masters, *Jour. R. Hort. Soc.* xiv. 220. — Hansen, *Jour. R. Hort. Soc.* xiv. 421 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 23, f. 8, J. K. Q. — Fox, *Rep. Forest Comm. N. Y.* 1894, 126, t.

Picea nigra, var. **glauca**, Carrière, *Traité Conif.* 242 (1855).

Pinus rubra, var. **arctica**, Lawson & Son, *List No. 10, Abietineæ*, 19 (1851). — Courtin, *Fam. Conif.* 64.

Pinus rubra, var. **arctica longifolia**, Lawson & Son, *List No. 10, Abietineæ*, 19 (1851).

Pinus rubra, var. **cœrulea**, Lawson & Son, *List No. 10, Abietineæ*, 19 (1851). — Courtin, *Fam. Conif.* 64.

Abies laxa, K. Koch, *Dendr.* ii. pt. ii. 243 (1873).

Picea laxa, Sargent, *Garden and Forest*, ii. 496 (1888). — J. G. Jack, *Garden and Forest*, x. 63.

Picea rubra pusilla, Peck, *The Spruces of the Adirondacks*, 10 (1897).

A tree, with strong-smelling foliage,[1] sometimes one hundred and fifty feet in height, with a trunk three or four feet in diameter, but east of the Rocky Mountains, and especially toward the southeastern limits of its range, reaching an average maximum height of sixty or seventy feet and an average trunk diameter of two feet. The long comparatively thick limbs sweep out in graceful upward curves and form a broad-based and rather open irregular pyramid which is often obtuse at the apex, and are densely clothed with stout rigid pendent lateral branches, the ultimate branchlets frequently incurving from near the middle. The bark of the trunk is from one quarter to one half of an inch in thickness, and separates irregularly into thin plate-like scales which are light gray more or less tinged with brown on the surface. The branchlets are stout, pale gray-green when they first appear, and glabrous or slightly puberulous;[1] during their first autumn and winter they are orange-brown and then gradually grow darker and grayish brown. The winter-buds, which are broadly ovate and obtuse, are covered by light chestnut-brown scales rounded at the apex, with thin often reflexed ciliate margins, and vary from an eighth to nearly a quarter of an inch in length according to the vigor and stoutness of the branchlets. The leaves are crowded on the upper side of the branches by the twisting of those on the lower side, and point forward, especially those near the extremities of the branchlets; they are tetragonal, incurved, and acute or acuminate at the apex, which terminates in a rigid callous tip, and are pale blue and hoary when they first appear, becoming dark blue-green or pale blue at maturity, individual trees varying greatly in the depth and brightness of the shades of blue of their foliage; they are marked on each of the four sides with three or four rows of stomata, and are from one third of an inch in length on fertile upper branches to three quarters of an inch in length on the lower sterile branches of young and vigorous trees. The staminate flowers are oblong-cylindrical and pale red when they first emerge from the buds, but soon appear yellow from their thick covering of pollen; they are from one half to three quarters of an inch in length at maturity, when they are suspended on slender pedicels nearly half an inch long. The pistillate flowers are oblong-cylindrical, with round nearly entire pale red or yellow-green scales broader than they are long, and nearly orbicular denticulate bracts. The cones, which are nearly sessile or are borne on very short thin straight stems, are oblong-cylindrical, slender, slightly narrowed to both ends and rather obtuse at the apex, and are usually about two inches long and from one third to two thirds of an inch in diameter, but vary from an inch to two inches and a half in length; their scales are nearly orbicular or somewhat longer than they are broad, rounded, truncate, slightly emarginate or rarely narrowed at the apex, and obscurely striate, with thin usually entire margins; when fully grown they are pale green, often somewhat tinged with red,[2] and at maturity they become pale brown and lustrous, and are so thin and flexible that the dry cone is easily compressed between the fingers without injuring the scales; they generally fall in the autumn or during the following winter, soon after the escape of the seeds. These are about an eighth of an inch in length and pale brown, with narrow wings which gradually broaden from the base to above the middle and are very oblique at the apex.

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[1] The foliage and young branchlets of the White Spruce emit a powerful polecat odor, which, although it varies in degree in different individuals, offers a sure method of distinguishing this tree at all seasons of the year from the other American Spruces, with the exception of *Picea Engelmanni*. The foliage of this tree has also the polecat odor, but less strongly developed than in the White Spruce.

The White Spruce inhabits the banks of streams and lakes and the borders of swamps, in rich moist alluvial soil, ocean cliffs, and less commonly at the north the rocky slopes of low hills; it ranges from the shores of Ungava Bay in Labrador westward to those of Hudson Bay, and from the mouth of Seal River not far to the north of Cape Churchill it is scattered along the northern frontier of the forest nearly to the shores of the Arctic Sea, and, crossing the continental divide, reaches Behring Strait in 66° 44′ north latitude. Southward it extends down the Atlantic coast to southern Maine,[3] growing often close to the shore, where it is constantly bathed in the spray of the ocean, and to northern New Hampshire, northeastern Vermont, northern New York, northern Michigan[4] and Minnesota and the Black Hills of Dakota, and through the interior of Alaska and along the Rocky Mountains to northern Montana.

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[1] In the interior of Alaska and in British Columbia the branchlets of the *White Spruce* are sometimes slightly puberulous; in the east the branchlets appear to be always entirely glabrous.

[2] In a swamp near Banff, Alberta, I have seen in August White Spruce trees bearing bright red cones and others pale green cones.

[3] On the coast of Maine *Picea Canadensis* grows as far south as the shores of Casco Bay. (See *Garden and Forest*, ix. 351, f. 47.)

[4] In the southern peninsula of Michigan, *Picea Canadensis* is common on the Au Sable River and northward (*teste* W. J. Beal).

In Labrador the White Spruce is widely but not generally distributed, growing in the south in well-watered valleys and ascending rocky hills to elevations of two thousand feet above the sea-level, but north of the southern watershed it is confined to river-valleys.[1] West of Hudson Bay it often grows to a large size on river terraces to the very borders of the barren lands, following down the Telzoa River nearly to the shores of Doobaunt Lake;[2] it was found by Richardson on the Copper Mine River, within twenty miles of the Arctic Sea, growing to a height of twenty feet,[3] and its stems choke the mouths of every arctic American river, strewing the adjacent shores with heaps of driftwood and testifying to its abundance on their shifting banks. In the basin of the Yukon the White Spruce is the largest and most valuable tree, attaining a large size on alluvial bottom-lands, where it is very abundant, while on adjacent hills it remains small and stunted.[4] On the northwest coast the White Spruce is able to exist farther north than other trees, and to form scattered groves near the sea from the shore of Norton Sound to the Nootak River, where, with short stout trunks and crowded branches densely clothed with thick leaves, it lives through the long arctic winter and sometimes rises to the height of fifty feet.[5] The White Spruce is common in Newfoundland and the Maritime Provinces, and on the streams which flow from the north into the St. Lawrence, and westward it ranges through Ontario to the borders of the treeless plains in Manitoba, where it occupies sand-hills and the dry slopes of river banks.[6] Less abundant and less generally distributed in the central region of British America than the Black Spruce, it forms groves sometimes of large trees on the alluvial bottoms of the Saskatchewan, Churchill, and Athabasca Rivers;[7] in the valleys of the Rocky Mountains of Alberta, British Columbia, and northern Montana, it lines the banks of streams and lakes up to elevations of five thousand feet, and attaining its largest size and its greatest beauty, sends up tall spire-like heads of dark foliage. It grows in small groves on the Cypress hills in Assiniboine;[8] and among the Black Hills of Dakota it is the largest and one of the most abundant coniferous trees, often reaching a height of more than one hundred feet in the neighborhood of streams. It is common in the region north of Lake Superior, but east of the Mississippi it nowhere extends very far south of the northern boundary of the United States, and is not a large or valuable tree.

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[1] "The White Spruce is widely distributed throughout the Labrador peninsula, but, unlike the Black Spruce, it is not met with in all localities, and its distribution appears to depend almost wholly on the character of the soil, and only to a limited extent upon climate. It is found on both the eastern and western sides of the peninsula, and its northern limit almost coincides with that of the Black Spruce. Along the St. Lawrence, and inland to about latitude 51°, large trees of this species are abundant in the valleys and far up the sides of the rocky and drift-covered hills (1,000 to 2,000 feet), where they grow to commercial size along with White Birch and the Aspen. Farther northward the Black Spruce gradually replaces them on the rocky hillsides, and the White Spruce appears to be confined to the modified drift of the river terraces, where the trees are conspicuous for their size, being much larger and longer than the Black Spruce. On the central table-land (nearly 2,000 feet above sea-level) to the northward of latitude 52°, White Spruce is rarely found on the great area of archæan crystalline rocks with its overlying soil of sandy glacial drift; and it is found only in small patches on the sides of the hills with small White Birches, and usually growing on the modified drift along the borders of the smaller mountain streams.

"On the large areas of stratified Cambrian rocks, about the upper waters of the Hamilton River, White Spruce grows freely and to large size (3 feet diameter) on the hillsides, with a heavy rich soil formed by the disintegration of the ferruginous limestones and shales beneath, and is here found as far north as latitude 54°. On the archæan area, northward of latitude 53°, White Spruce is found only in the river-valleys of the eastern, northern, and western watersheds, where it grows on the terraces that flank the rocky walls of the valleys, and is nearly always associated with White Birch and sometimes with Aspen and Balsam Poplar.

"White Spruce trees are the only conifers found growing on the outer islands of James Bay; and this is probably due to the soil being very similar to the modified drift of the river terraces of the mainland, as the islands are formed from the drift of a terminal moraine, rearranged by marine action during a post-glacial subsidence. The islands along the east shore of Hudson Bay are often rocky, and, where wooded, the trees are mostly Black Spruces, with some White Spruce on the marine terraces." (Low *in litt.* See, also, Low, *Rep. Geolog. Surv. Can.* n. ser. viii. 34 L.)

[2] Tyrrell, *Rep. Geolog. Surv. Can.* n. ser. ix. 214 F. See, also, Tyrrell, in *The Canadian Magazine*, vii. 524 (*Through the Sub-Arctics of Canada*).

[3] *Franklin Jour.* Appx. No. 7, 752.

[4] Dall, *Alaska and its Resources*, 439. — G. M. Dawson, *Geolog. Surv. Can.* n. ser. iii. pt. i. 112 B, 116 B, 121 B.

[5] As *Abies arctica* A. Murray has described the White Spruce of northwestern Alaska, which he distinguished by its broader pulvini, thicker leaves, and smaller cones, with more concave scales and bracts of a somewhat different shape (*Jour. Bot.* v. 253, t. 269 [1867]). These are slight differences, which may well have been the result of the severe climate of the region where the officers of H. M. S. Herald discovered this tree, which, judging from the figure, I cannot distinguish from ordinary northern forms of *Picea Canadensis.*

It is also the *Pinus alba, β arctica*, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 414 (1868), and the *Picea alba*, var. *arctica*, F. Kurtz, *Bot. Jahrb.* xix. 425 (*Fl. Chilcatgebietes*) (1895).

[6] Macoun, *Cat. Can. Pl.* 469.

[7] Tyrrell, *Rep. Geolog. Surv. Can.* n. ser. viii. 12 D.

[8] Macoun, *l. c.* 470.

The wood of *Picea Canadensis* is light, soft, not strong, and straight-grained, with a satiny surface; it contains numerous prominent medullary rays, few resin passages, and thin inconspicuous bands of small summer cells, and is light yellow, with thin hardly distinguishable sapwood. The specific gravity of the absolutely dry wood is 0.4051, a cubic foot weighing 25.25 pounds. In the eastern provinces of Canada, where it is probably the only Spruce which is cut in large quantities for lumber, it is used in construction and for the interior finish of buildings, and for paper pulp, and is largely exported to Europe. White Spruce lumber is also occasionally manufactured in Dakota and Montana, and from this tree the miners of the Yukon obtain their lumber and the logs for their huts. The Indians of the north used the long tough flexible roots of the White Spruce, and probably also those of the Black Spruce, to fasten together the sheets of Birch bark from which they made their canoes, and to weave water-tight baskets and vessels,[1] and from the bark of young Spruce-trees they made canoes when the Birch could not be found.[2]

The Spruce-trees which Jacques Cartier saw as he sailed up the Saguenay River in the autumn of 1535 were probably White Spruces,[3] and it was the White Spruce which John Mason, writing in 1620, included among the valuable timber-trees of Newfoundland.[4] First described by Miller in 1731,[5] the White Spruce is said to have been cultivated by Bishop Compton in England before the end of the sixteenth century.[6]

Picea Canadensis excels the other Spruces of eastern North America in massiveness of trunk and in richness and beauty of foliage; and in regions sufficiently cold to insure the full development of all its charms, no other Spruce-tree grows more vigorously or better adapts itself, with persistent lower branches and shapely form, to decorate the parks and gardens of the north, although in the comparatively mild climate of southern New England and the middle states, and of western and central Europe, it soon perishes or loses its value as an ornamental tree.

A number of forms of the White Spruce,[7] some with leaves of darker or lighter shades of blue and others of dwarf habit or with erect or pendent branches, are occasionally propagated in nurseries.

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[1] "Watape is the name given to the divided roots of the spruce-fir, which the natives weave into a degree of compactness that renders it capable of containing a fluid. The different parts of the bark canoes are also sewed together with this kind of filament." (Mackenzie, *Voyages from Montreal on the River St. Lawrence and through the Continent of North America to the Frozen and Pacific Oceans in the Years 1789 and 1793*, 37. See, also, Richardson, *Franklin Jour.* Appx. No. 7, 752.)

[2] Richardson, *Arctic Searching Exped.* ii. 316.

[3] "Depuis le 19 jour jusques au 28, dudict moys nous auons esté nauigans a mont ledict fleuve sans perdre heure ny jour, durand lequel temp auos veu & trouvé d'aussi beau pays & terres aussi vuyes que l'on scauroit desirer, plaine comme dict est des beaulx arbres du monde, scauoir chesnes, hormes, noyers, cedres, pruches, fresnes, briez, fandres, oziers, & force vignes." (*Bref Recit et Succincte Narration de la Navigation faite in MDXXXV. MDXXXVI. Par le Captain Jacques Cartier aux Iles de Canada* 24.)

[4] "The Land of the North parts most mountanye & woodye very thick of Firre trees, Spruce, Pine, Lereckhout, Aspe, Hasill, a kind of stinking wood; the three formest goodly Timber and most convenient for building." (John Mason, *A Briefe Discourse of the New-found-land.*)

[5] *Abies; Piceæ foliis brevioribus, conis parvis, biuncialibus laxis*, *Dict.* No. 6.

Abies Canadensis, piceæ foliis brevioribus, conis parvis, biuncialibus, laxis, Charlevoix, *Histoire de la Nouvelle France*, ed. 12mo. iv. 369, f.

[6] Loudon, *Arb. Brit.* iv. 2310, f. 2224.

[7] The handsomest of the numerous cultivated forms of the White Spruce is the tree with light blue leaves rather closely pressed against the branches, which has been known in gardens under one name or another for more than a century. It is: —

Picea Canadensis glauca, Sudworth, *Bull.* No. 14, *Div. Forestry, U. S. Dept. Agric.* 37 (1897).

Pinus glabra, Moench, *Bäume Weiss.* 73 (1785).
Abies rubra cærulea, Loudon, *Arb. Brit.* iv. 2316 (1838).
Abies cærulea, Forbes, *Pinetum Woburn.* 99 (1839).
Picea cærulea, Link, *Linnæa*, xv. 522 (1841).
Pinus rubra, B *violacea*, Endlicher, *Syn. Conif.* 114 (1847).
Abies alba cærulea, Carrière, *Traité Conif.* ed. 2, 320 (1867).
Abies Americana cærulea, Beissner, *Handb. Conif.* 509 (1887).
Picea alba cærulea, Beissner, *Handb. Nadelh.* 341 (1891).

The other forms of the White Spruce found in European gardens, dwarf in habit or more or less abnormal in mode of growth or in the color of their foliage, have little to recommend them as ornamental plants. (For a description of these varieties, see Beissner, *l. c.* 342.)

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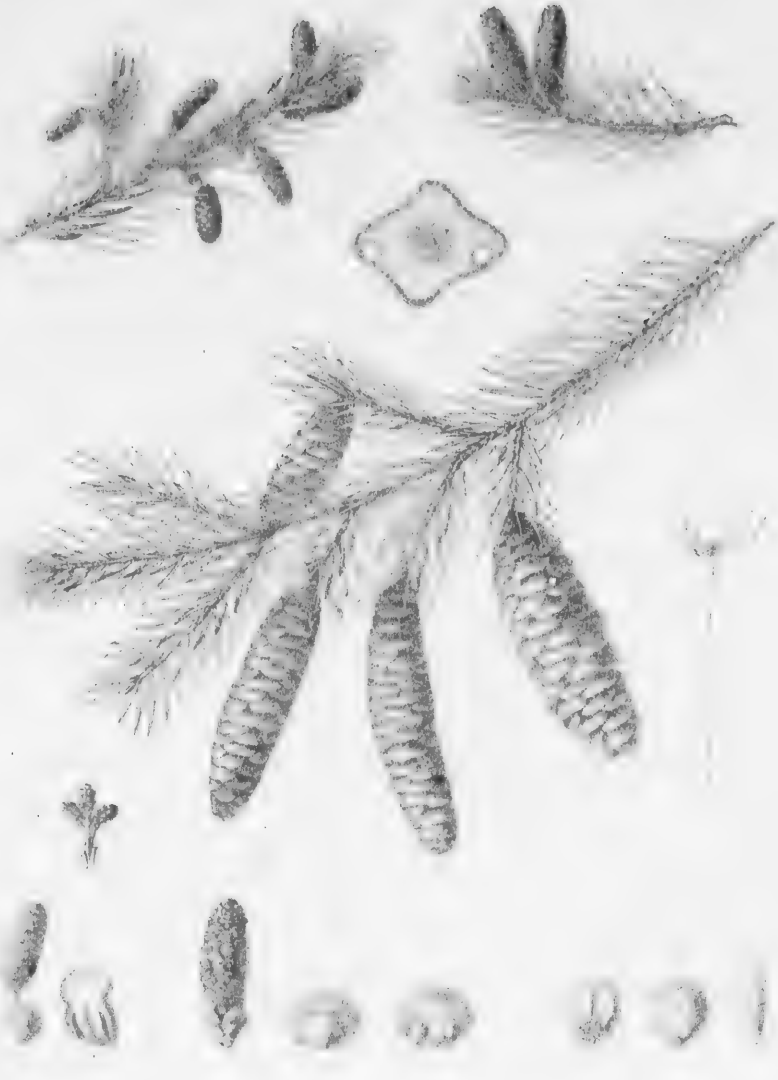
EXPLANATION OF THE PLATE.

PLATE DXCVIII. PICEA CANADENSIS.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. A branch with pistillate flowers, natural size.
5. A pistillate flower, enlarged.
6. A scale of a pistillate flower, lower side, with its bract, enlarged.
7. A scale of a pistillate flower, upper side, with its ovules, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. A cone-scale, lower side, with its bract, natural size.
11. A seed, lower side, enlarged.
12. Cross section of a leaf magnified fifteen diameters.
13. Winter-buds, natural size.
14. A seedling plant, natural size.



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EXPLANATION OF THE PLATE.

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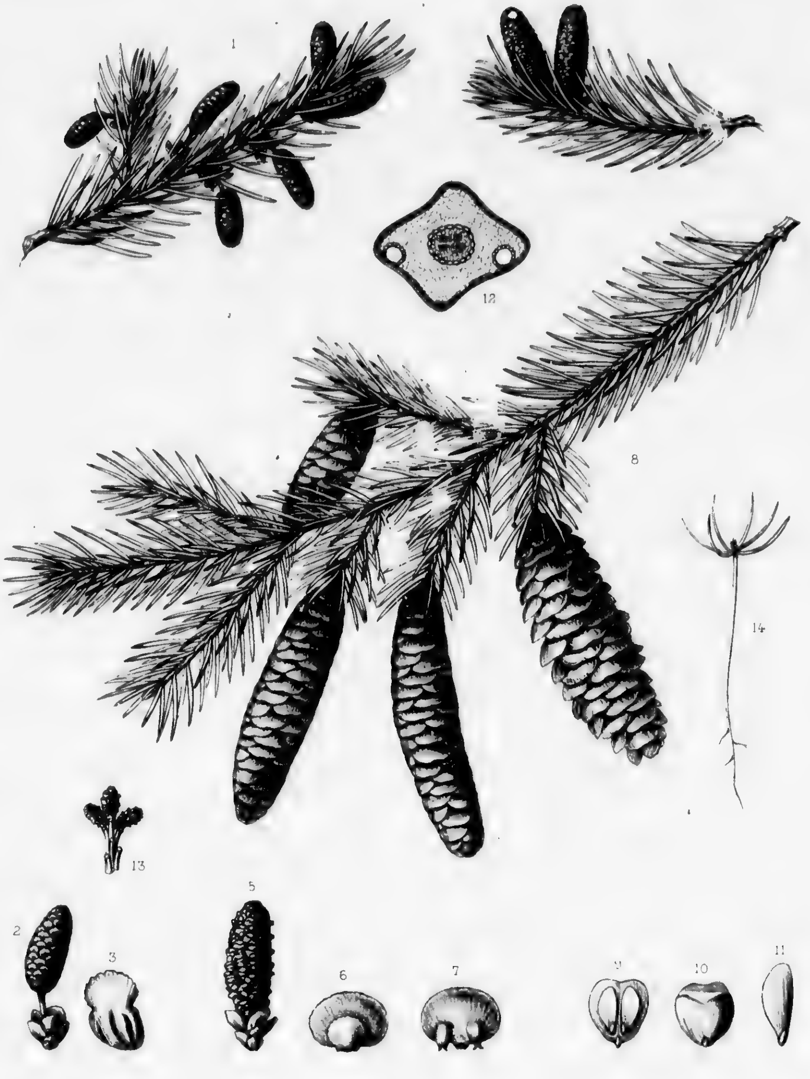
An anther, front view, enlarged.

4. A branch with pistillate flowers, natural size.
5. A pistillate flower, enlarged.
6. A scale of a pistillate flower, lower side, with its bract, enlarged.
7. A scale of a pistillate flower, upper side, with its ovules, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. A cone-scale, lower side, with its bract, natural size.
11. A seed, lower side, enlarged.
12. Cross section of a leaf magnified fifteen diameters.
13. Winter-buds, natural size.
14. A seedling plant, natural size.



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PICEA ENGELMANNI.

White Spruce. Engelmann Spruce.

Cones oblong-cylindrical or oval, their scales narrowed to a truncate or acute apex, or obovate and rounded, erose-dentate or entire. Branchlets pubescent. Leaves soft and flexible, blue-green.

Picea Engelmanni, Engelmann, *Trans. St. Louis Acad.* ii. 212 (1863); *Gard. Chron.* 1863, 1035; n. ser. vii. 790; xi. 334; xvii. 145; *Gartenflora*, xiii. 244; *Rothrock Wheeler's Rep.* vi. 256. — Carrière, *Traité Conif.* ed. 2, 348. — Sénéclauze, *Conif.* 24. — G. M. Dawson, *Can. Nat.* n. ser. ix. 325. — Regel, *Russ. Dendr.* ed. 2, pt. i. 33. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 205. — Coulter, *Man. Rocky Mt. Bot.* 431. — Mayr, *Wald. Nordam.* 352. — Lemmon, *Rep. California State Board Forestry*, iii. 113, t. 2 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 51; *Bull. Sierra Club*, ii. 159, t. 23 (*Conifers of the Pacific Slope*), Beissner, *Handb. Nadelh.* 343, f. 97. — Masters, *Jour. R. Hort. Soc.* xiv. 221. — Hansen, *Jour. R. Hort. Soc.* xiv. 422 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 24, f. 8, M.

Abies nigra, Engelmann, *Am. Jour. Sci.* ser. 2, xxxiv. 330 (not Du Roi) (1862).

Abies Engelmanni, Parry, *Trans. St. Louis Acad.* ii. 122 (1863); *Am. Nat.* viii. 179; *Proc. Davenport Acad.* i. 149. — Henkel & Hochstetter, *Syn. Nadelh.* 418. — Hoopes, *Evergreens*, 177, f. 22. — Watson, *King's Rep.* v. 332; *Pl. Wheeler*, 17. — Porter & Coulter, *Fl. Colorado; Hayden's Surv. Misc. Pub.* 130. — K. Koch, *Dendr.* ii. pt. ii. 242. — Hall, *Bot. Gazette*, ii. 95. — Veitch, *Man. Conif.* 68. — Lauche, *Deutsche Dendr.* ed. 2, 92.

Pinus commutata, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 417 (1868).

Abies commutata, A. Murray, *Gard. Chron.* n. ser. iii. 106 (1875). — Gordon, *Pinetum*, ed. 2, 5.

Picea Engelmanni, var. **Franciscana**, Lemmon, *West-American Cone-Bearers*, 51 (1895).

Picea Columbiana, Lemmon, *Garden and Forest*, x. 183 (1897); *Bull. Sierra Club*, ii. 158 (*Conifers of the Pacific Slope*).

A tree, often one hundred and fifty feet in height, with a trunk four or five feet in diameter, or frequently, on high mountains at the extreme upper limits of its range, reduced to a shrub with semiprostrate stems. During its early years the slender spreading branches, which are produced in regular whorls one close above another, form a narrow compact symmetrical pyramid, and in old age the trees, which generally grow only in dense forests, either gregariously or mixed with other alpine conifers, produce long naked trunks surmounted by narrow pyramidal heads of short small branches usually pendulous below, horizontal above, and nearly erect at the summit, and gracefully hanging short lateral branchlets. The bark of the trunk is from one quarter to one half of an inch in thickness, light cinnamon-red, and broken into large thin loose scales. The winter-buds are conical or often slightly obtuse, with pale chestnut-brown scales which are scarious and often free or slightly reflexed on the margins. The branchlets, which are comparatively slender, or on trees in high exposed positions often much thickened, are pubescent for three or four years; when they first appear they are pale greenish yellow, turning light or dark orange-brown or gray tinged with brown during their first winter, and then gradually become darker, the thin bark beginning to separate into small flaky scales in their fourth or fifth years. The leaves are soft and flexible, with a strong unpleasant polecat-like odor when bruised, and stand out from all sides of the branch, pointing forward; they are tetragonal, acute, with callous tips, slender, nearly straight, or slightly incurved on vigorous sterile branches, and stouter, shorter, and more incurved on fertile branches, and from an inch to an inch and an eighth in length. They are marked on each face with from three to five rows of small stomata, which are more conspicuous on the upper than on the lower side; when they first appear they are covered with a pale glaucous bloom, which disappears during their first summer, leaving them dark blue-green or pale steel-blue. The staminate flowers are oblong-cylindrical, and about five eighths of an inch long and a quarter of an inch thick, with dark purple anthers, and are raised on slender stems often nearly a quarter of an inch long when fully grown. The pistillate flowers are oblong-cylindrical, bright scarlet, and from one third to five eighths of an inch in length, with pointed or rounded and more or less divided or entire scales, their bracts being oblong and rounded, or acute or acuminate and denticulate at the apex, or obovate-oblong and abruptly acuminate. The cones are oblong-cylindrical or oval, gradually narrowed to both ends and usually about two inches long, although they vary in length from one inch to three inches, with thin flexible striate scales which are slightly concave, very thin, and generally erose-dentate or rarely almost entire on the margins, and are usually broadest at the middle, wedge-shaped below, and gradually contracted above to a truncate or rarely acute apex, or occasionally they are obovate and rounded above; the cones, which are sessile or very short-stalked, are borne in great numbers on the upper branches, even the prostrate shrubs at the upper limits of tree-growth being often covered with small cones; they are horizontal and ultimately pendulous, and when fully grown are light green somewhat tinged with scarlet, with scales which are spreading or appressed, and light chestnut-brown and lustrous at maturity; they mostly fall in the autumn or early in their first winter and soon after the escape of the seeds.[1] These are rather obtuse at the base, nearly black, and generally about half as long as their broad and very oblique wings.

From the Rocky Mountains of Alberta and British Columbia *Picea Engelmanni* is distributed southward over the interior mountain systems of the continent to northern New Mexico and Arizona, forming great forests at elevations of from five thousand feet at the north up to eleven thousand five hundred feet at the south, and westward through Montana, Idaho, Washington, and Oregon, where it is usually scattered among other trees.[2] Attaining its greatest size and beauty north of the northern boundary of the United States, the Engelmann Spruce forms the largest part of the great forests which clothe the high mountains of southern Alberta, those which overlook the valley of the Columbia in British Columbia, and the Selkirk Mountains.[3] The Spruce forests are less extensive in the region immediately south of the boundary of the United States, although the Engelmann Spruce is a common tree in the mountain forests of Montana and Idaho,[1] and ranges westward along the high mountains of northern Washington and southward along both slopes of the Cascade Mountains to southern Oregon, and over the Powder River and Blue Mountains of eastern Washington and Oregon. It is common on the Yellowstone plateau of northwestern Wyoming,[2] and southward occurs on all the mountain ranges which rise ten thousand feet above the sea-level. It is the principal and most valuable timber-tree of Colorado and Utah, forming great forests on all the high ranges, generally growing to its largest size at elevations of between nine thousand five hundred and ten thousand feet, but occasionally descending to nine thousand feet and ascending to eleven thousand feet above the sea, and with *Pinus aristata* reaching the extreme upper limits of the timber-line, where, although usually semiprostrate, it sometimes develops a tall erect stem. It likewise forms forests on the high mountains of eastern Nevada, and on the San Francisco Peaks in northern Arizona, where it ranges from nine thousand two hundred feet up to eleven thousand five hundred feet, reaching with *Pinus aristata* the highest limit of tree-growth;[3] it also grows in Arizona on Mount Graham and the Sierra Blanca, and near the summit of the Mogollon Mountains in New Mexico.[4]

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[1] In the size of its cones and in the shape of its cone-scales and their bracts, *Picea Engelmanni* shows greater variation than the other North American species of Picea. In Colorado, Utah, and Arizona the cone-scales are rhomboidal, more or less truncate at the apex, entire or erose-denticulate to a greater or less degree on the margins, and appressed or spreading, their bracts being usually oblong and rounded or acute at the apex, or rarely acuminate, while the cones vary from an inch to three inches in length on adjacent trees. (See Brandegee, *Bot. Gazette*, iii. 32.) Farther northward, especially in northern Wyoming, northern Montana, and in Alberta, some trees bear large cones with truncate scales, but others produce cones generally about an inch and a half long with oblong-obovate scales rounded above and frequently nearly entire on the margins, their bracts varying from oblong-rounded to acuminate. These cones, seen by themselves, might well suggest another species, but they are connected with those of the other extreme form by a long series of intergrading forms; and in habit, bark, and foliage the trees which produce the different kinds are not distinguishable.

[2] On the mountains of the upper Columbia Basin, in the United States, *Picea Engelmanni*, although generally scattered, is less common than it is on the Rocky Mountains, and often of smaller size, although on the northern slopes of Mount Hood in Oregon, where it is abundant in the Hemlock and Fir forests between altitudes of three thousand and six thousand feet, it frequently attains a height of one hundred and twenty-five feet and a trunk diameter of three feet on the shores of lakes and streams, while on dry hillsides it is much smaller and stunted in appearance. Farther southward *Picea Engelmanni* grows near Upper Klamath Lake in swampy ground down to elevations of about two thousand five hundred feet above the sea. This is the lowest station where I have seen it, except near Priest Lake in the extreme northern part of Idaho, where it descends to two thousand three hundred feet. On the west side of the Cascade Mountains *Picea Engelmanni*, although not common, grows along the whole length of the range, and is usually found only in small groves in moist or swampy situations. It is said by Mr. A. J. Johnson to grow in the coast range on Saddle Mountain, a few miles south of Astoria, Oregon, between elevations of three thousand and six thousand feet above the sea-level.

This western form is the *Picea Columbiana* of Lemmon (*Garden and Forest*, x. 183), who has tried to distinguish it from the tree of the Rocky Mountains by its smaller size, rather different habit, scaly bark, and smaller cones with "thin obovate obtuse scales" with "scarious wrinkled edges." The cones, however, of the Spruce of the Cascades and of the Blue Mountains of Washington and Oregon which I have seen do not differ materially in size and shape from those produced in Colorado and Arizona, showing less variation from them than from the cones on some trees in the northern Rocky Mountains. Mr. Lemmon describes the bark of *Picea Engelmanni* as "thick, brown, and deeply furrowed," but wherever I have seen this tree from Alberta and British Columbia to Arizona it has the scaly cinnamon-red bark which is characteristic of the trees of the Columbian basin and the western slope of the Cascade Mountains.

[3] The most northern stations where I have seen *Picea Engelmanni* are on the mountains above Laggan, on the line of the Canadian Pacific Railroad in Alberta, and on the Selkirk Mountains in

The wood of *Picea Engelmanni* is very light, soft, not strong, and close and straight-grained, with a satiny surface; it is pale yellow tinged with red, with thick hardly distinguishable sapwood, numerous conspicuous medullary rays, few minute resin passages, and inconspicuous bands of small summer cells. The specific gravity of the absolutely dry wood is 0.3449, a cubic foot weighing 21.49 pounds. It is largely manufactured into lumber for the construction of buildings, and is also extensively used for fuel and charcoal. The bark is employed locally in tanning leather.

Picea Engelmanni, which the botanists who first visited the Rocky Mountains[5] mistook for one of the Spruces of the east, was first distinguished in 1862 by Dr. C. C. Parry,[6] who found it on Pike's Peak in Colorado. The following year he sent seeds to the Botanic Garden of Harvard University at Cambridge, where this tree was probably first cultivated. It grows more slowly in New England, where it is very hardy, than the other Spruces and Firs of the Rocky Mountains,[7] forming a narrow symmetrical compact pyramid beautiful in shape and color; and in the Arnold Arboretum it has already produced a few cones. Unfolding its buds very early in the spring, like other trees which grow naturally only at high elevations, *Picea Engelmanni* suffers in western Europe from late spring frosts, but in northern Russia it has proved one of the hardiest of exotic conifers.[8]

In its specific name this tree, the fairest of its race, braving the fiercest mountain blasts, the fiery rays of the southern sun and the arctic cold of the northern winter, with tall and massive shafts

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British Columbia; but in southern Alberta and southern British Columbia it grows to such a large size up to high altitudes and is so generally distributed that no doubt it ranges much farther northward along the Rocky Mountains. By Macoun (*Cat. Can. Pl.* 470) it is stated that specimens collected on the Pease River plateau (latitude 55° 46′ 54″, longitude 120°, altitude 2,600 feet) are referable to *Picea Engelmanni*, while trees on the Athabasca (latitude 54° 7′ 34″, longitude 118° 48′) belong to *Picea Canadensis*, but I have not been able to see any specimen of *Picea Engelmanni* gathered north of the line of the Canadian Pacific Railroad.

[1] See Leiberg, *Contrib. U. S. Nat. Herb.* v. 47.

[2] Tweedy, *Flora of the Yellowstone National Park*, 12, 74.

[3] Merriam, *North American Fauna*, No. 3, 121.

[4] Rusby, *Bull. Torrey Bot. Club*, ix. 80.

[5] On the 9th of September, 1805, Lewis and Clark, being then in the second year of their transcontinental journey, were crossing the Bitter Root Mountains by the Lolo Trail, and found that the timber was "almost exclusively pine, chiefly of the long-leaved kind, with some spruce and a sprinkling of fir resembling the Scotch Fir" (*History of the Expedition under the Command of Lewis and Clark*, ed. Coues, ii. 590). This Spruce of the Bitter Root Mountains must have been *Picea Engelmanni*, which here first makes its appearance in literature. (See Sargent, *Garden and Forest*, x. 29.)

[6] See vii. 130.

[7] *Picea Engelmanni* grows slowly also in its native forests. A tree near the mining town of Cripple Creek in Colorado, examined by General Henry L. Abbot in 1896, had a trunk twelve inches in diameter five feet from the surface of the ground and six inches in diameter forty feet from the ground, and was two hundred and fifty years old. The log specimen cut in Colorado for the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is twenty-three inches in diameter inside the bark and four hundred and ten years old, with sixty-eight years of sapwood, which is three eighths of an inch in thickness. At the end of one hundred years the trunk of this tree was only five and a quarter inches in diameter, and at the end of its second century only eleven inches.

[8] André, *Gard. Chron.* n. ser. vii. 562.

brilliant in color, and graceful spire-like crowns of soft foliage of tenderest hue, keeps green on a thousand mountain-tops the memory of a good and wise man.[1]

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[1] See viii. 84.

EXPLANATION OF THE PLATE.

Plate DXCIX. Picea Engelmanni.

1. A branch with staminate flowers, natural size.
2. An anther, front view, enlarged.
3. A branch with pistillate flowers, natural size.
4. A scale of a pistillate flower, upper side, with its ovules, enlarged.
5. A scale of a pistillate flower, lower side, with its bract, enlarged.
6. A fruiting branch, natural size.
7. A cone from Mount Hood, Oregon, natural size.
8. A cone from the San Francisco Peaks, Arizona, natural size.
9. A cone-scale, lower side, with its bract, natural size.
10. A cone-scale, lower side, with its bract, natural size.
11. A cone-scale, upper side, with its seeds, natural size.
12. A cone-scale, lower side, with its bract, natural size.
13. A seed, enlarged.
14. An embryo, enlarged.
15. Cross section of a leaf magnified fifteen diameters.
16. Winter branch-buds, natural size.
17. A seedling plant, natural size.

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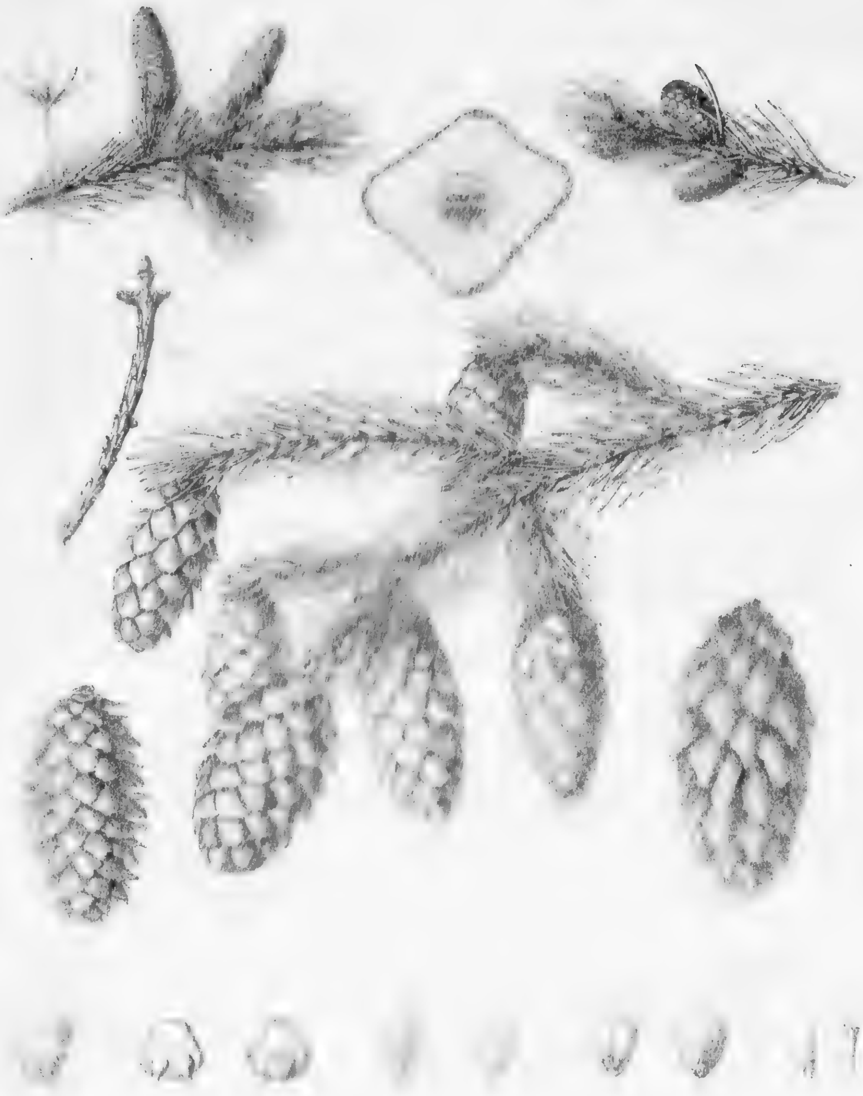

[illegible] soft foliage of [illegible] hue, keeps green on a [illegible] and wise man.[1]

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[1] See viii 84.

EXPLANATION OF THE PLATE.

[illegible] ENGELMANNI.

[illegible] natural size.

[illegible]

[illegible] natural size.

[illegible] with its ovules, enlarged.

[illegible] enlarged.

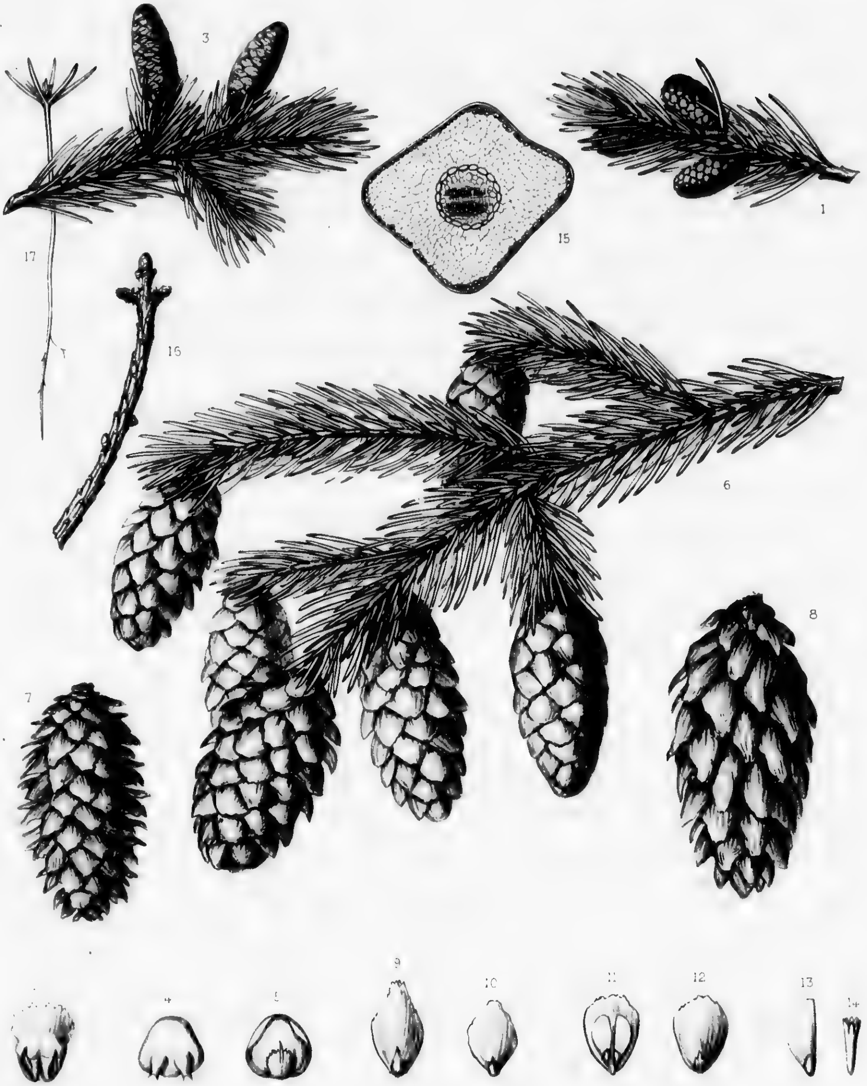
[illegible]

[illegible] enlarged.

[illegible] section of a leaf magnified fifteen diameters.

[illegible] Winter branch-buds, natural size.

1[illegible] A seedling plant, natural size.



PICEA ENGELMANNI, Engelm.

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PICEA PARRYANA.

Blue Spruce. Colorado Spruce.

Cones oblong-cylindrical, their scales rhomboidal, elongated, flexuose, rounded or truncate at the erose apex. Branchlets glabrous. Leaves rigid, spinescent, blue-green, or silvery white.

Picea Parryana.

Abies Menziesii, Engelmann, *Am. Jour. Sci.* ser. 2, xxxiv. 330 (not Lindley) (1862); *Gard. Chron.* n. ser. vii. 790. — Watson, *King's Rep.* v. 333 (in part). — André, *Gard. Chron.* n. ser. vii. 562. — Porter & Coulter, *Fl. Colorado; Hayden Surv. Misc. Pub.* No. 4, 131. — Brandegee, *Bot. Gazette*, iii. 33.

Picea Menziesii, Engelmann, *Trans. St. Louis Acad.* ii. 214 (not Carrière) (1863).

Abies Menziesii Parryana, André, *Ill. Hort.* xxiii. 198 (1876); xxiv. 53, 119. — Roezl, *Ill. Hort.* xxiv. 86.

Picea pungens, Engelmann, *Gard. Chron.* n. ser. xi. 334 (1879); xvii. 145. — Masters, *Gard. Chron.* n. ser. xx. 725, f. 130; ser. 3, x. 547, f. 73, 74; *Jour. R. Hort. Soc.* xiv. 223. — Regel, *Russ. Dendr.* ed. 2, pt. i. 37. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 205. — Coulter, *Man. Rocky Mt. Bot.* 431. — Mayr, *Wald. Nordam.* 352. — Beissner, *Handb. Nadelh.* 346. — Hansen, *Jour. R. Hort. Soc.* xiv. 437 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 24.

Abies Engelmanni glauca, Veitch, *Man. Conif.* 69 (1881).

Picea pungens, α viridis, Regel, *Russ. Dendr.* ed. 2, pt. i. 37 (1883).

Picea pungens, β glauca, Regel, *Russ. Dendr.* ed. 2, pt. i. 37 (1883).

A tree, usually from eighty to one hundred but occasionally one hundred and fifty feet in height, with a trunk which is rarely three feet in diameter, and is occasionally divided into three or four stout erect secondary stems. Until the age of thirty or forty years the branches of *Picea Parryana*, the most variable of all the American Spruces in habit, are horizontal, stout, rigid, and disposed in remote whorls, and, decreasing regularly in length from below upward, form a broad-based symmetrical pyramid, their short stout stiff branchlets pointing forward and making flat-topped masses of foliage; later some of the branches near the middle of the tree often grow more rapidly than those below them, and, spreading widely, turn upward toward the ends in graceful curves, shading and eventually killing those below them. On old trees, which are generally destitute of lower branches, the crown is thin, ragged, and pyramidal, with short remote branches and stout pendent branchlets; sometimes it is rounded by the lengthening and spreading of the upper branches, and often the lowest branches are pendent and the upper branches erect. The bark of young trees is gray or gray tinged with cinnamon-red and broken into small oblong plate-like scales, and on the lower part of old trunks it is from three quarters of an inch to an inch and a half in thickness and deeply divided into broad rounded ridges covered with small closely appressed pale gray or occasionally bright cinnamon-red scales. The winter-buds are stout, obtuse, or rarely acute, and from one quarter to nearly one half of an inch in length, with thin pale chestnut-brown scales rounded, scarious, and often more or less reflexed at the margins. The branchlets are stout, rigid, and glabrous, and when they first appear are pale glaucous green; becoming bright orange-brown during the first winter, they gradually grow darker in their second season and ultimately become light grayish brown. The leaves, which stand out from all sides of the branchlets and point forward, are strongly incurved near the middle, especially those on the upper side of the branch which form a flatter and more compact mass of foliage than those on the lower side; they are stout, rigid, tetragonal, acuminate at the apex, which terminates in a long callous sharp tip, from an inch to an inch and an eighth long on the sterile branches of young vigorous trees, and often not more than half an inch long on the fertile branches of old trees; they are marked on each of their four sides with from four to seven rows of stomata, more conspicuous on the upper than on the lower surface, and when they first appear are dull bluish green on some individuals and light or dark steel-blue or silvery white on others, the blue colors gradually changing to a dull blue-green at the end of three or four years. The staminate flowers are oblong-ovate, from one half to five eighths of an inch long and about one third of an inch thick, with yellow anthers tinged with red. The pistillate flowers are oblong-cylindrical and an inch in length, with broad oblong or slightly obovate scales which are pale green, truncate or slightly emarginate at the denticulate apex, and acute bracts. The cones are produced on the upper third of the tree and are sessile or short-stalked, oblong-cylindrical, slightly narrowed at the ends, and usually about three inches long, varying, however, from two to four inches in length and from an inch to an inch and a half in thickness, with flat tough rhomboidal scales which are flexuose on the margins, and acute, rounded, or truncate at the elongated erose apex, green more or less tinged with red when fully grown at midsummer, and slightly spreading after they open early in the autumn, when they are pale chestnut-brown and lustrous; they mostly do not fall from the branches until their second winter. The seeds are an eighth of an inch long and about half the length of their wings, which gradually widen to above the middle and are full and rounded at the apex.

Picea Parryana grows along the banks of streams and on the first benches above them singly or in small groves at elevations of between six thousand five hundred and nine thousand or occasionally ten thousand feet above the sea-level. Nowhere very abundant, it is generally scattered along the mountain streams of Colorado and eastern Utah, and northward to those of the Wind River Mountains of Wyoming.

The wood of *Picea Parryana* is very light, soft, weak, and close-grained, with a satiny surface; it is very light brown or often nearly white, with hardly distinguishable sapwood, and contains numerous prominent medullary rays, few small resin passages, and inconspicuous bands of small summer cells. The specific gravity of the absolutely dry wood is 0.3740, a cubic foot weighing 23.31 pounds.

Picea Parryana was discovered on Pike's Peak, Colorado, in 1862, by Dr. C. C. Parry, whose name it bears, and by whom seeds were sent the following year to the Botanic Garden of Harvard University at Cambridge. In the gardens of the eastern and northern United States and in those of the central prairie region of the continent, and of western and northern Europe, *Picea Parryana* has proved very hardy and has grown rapidly; its handsome pyramidal habit, with regularly whorled branches and broad frond-like masses of crowded leaves, and the blue color of the foliage on the young branches of some individuals, have commended it to the lovers of ornamental trees, and no conifer of recent introduction has been so generally planted in the United States during the last twenty years.[1] The bluest individuals lose, however, at the end of a few years much of their peculiar color; and the feeble growth of the lower branches on the oldest trees in cultivation, now thirty or forty feet in height, show that those branches will soon perish, and that *Picea Parryana*, although charming in its early years, is less well suited to become a permanent ornament of parks and gardens than trees which, producing more vigorous lower branches, maintain to old age the conical form, perfect from the ground up, which is essential to the greatest beauty of conifers of pyramidal habit.[2]

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[1] In European gardens varietal names have been attached to seedling plants of *Picea Parryana* differing slightly in color from what is considered to be the typical form, but none of them have much value or significance, as seedlings of this tree are always very variable and display innumerable tints in their foliage. Several of the varieties are described by Beissner (*Handb. Nadelh.* 345), who also describes a plant with pendulous branches as *Picea pungens glauca pendula*.

A long-leaved vigorous seedling plant raised in Germany is described by Ledien as *Picea pungens*, var. *König Albert von Sachsen* (*Gartenflora*, xl. 69, f. 22 [1891]).

[2] *Garden and Forest*, iv. 190.

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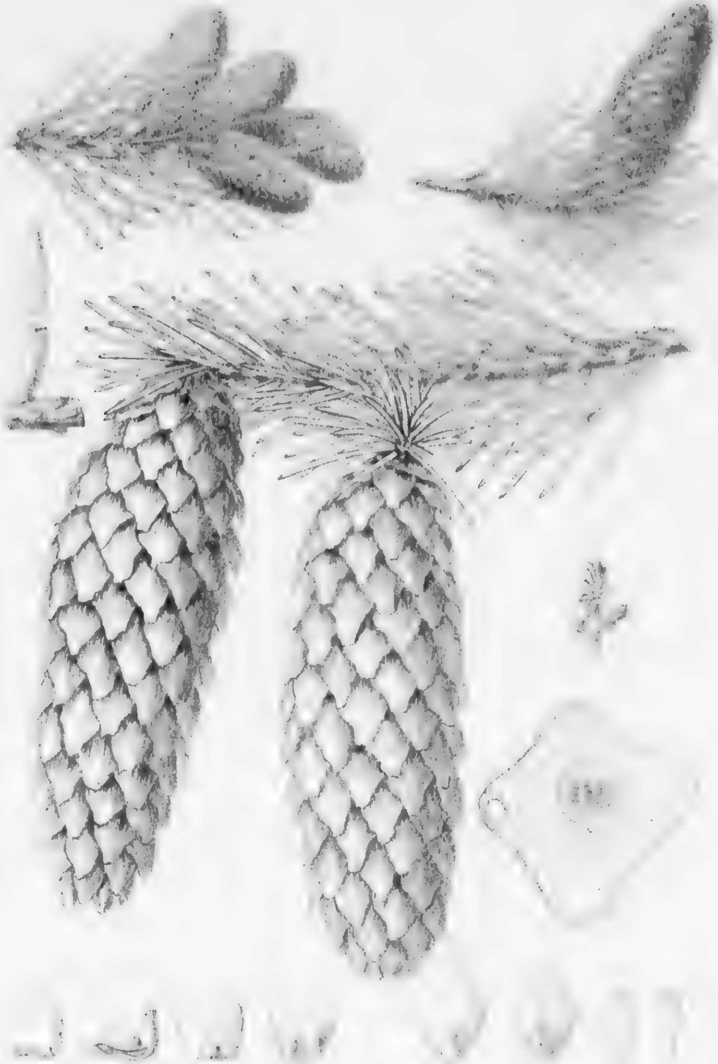
EXPLANATION OF THE PLATE.

Plate DC. Picea Parryana.

1. A branch with staminate flowers, natural size.
2. An anther, front view, enlarged.
3. An anther, side view, enlarged.
4. A branch with pistillate flowers, natural size.
5. A scale of a pistillate flower, lower side, with its bract, enlarged.
6. A scale of a pistillate flower, upper side, with its ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. Vertical section of a seed, enlarged.
11. An embryo, enlarged.
12. A leaf divided transversely, enlarged.
13. Cross section of a leaf magnified fifteen diameters.
14. Winter-buds, natural size.



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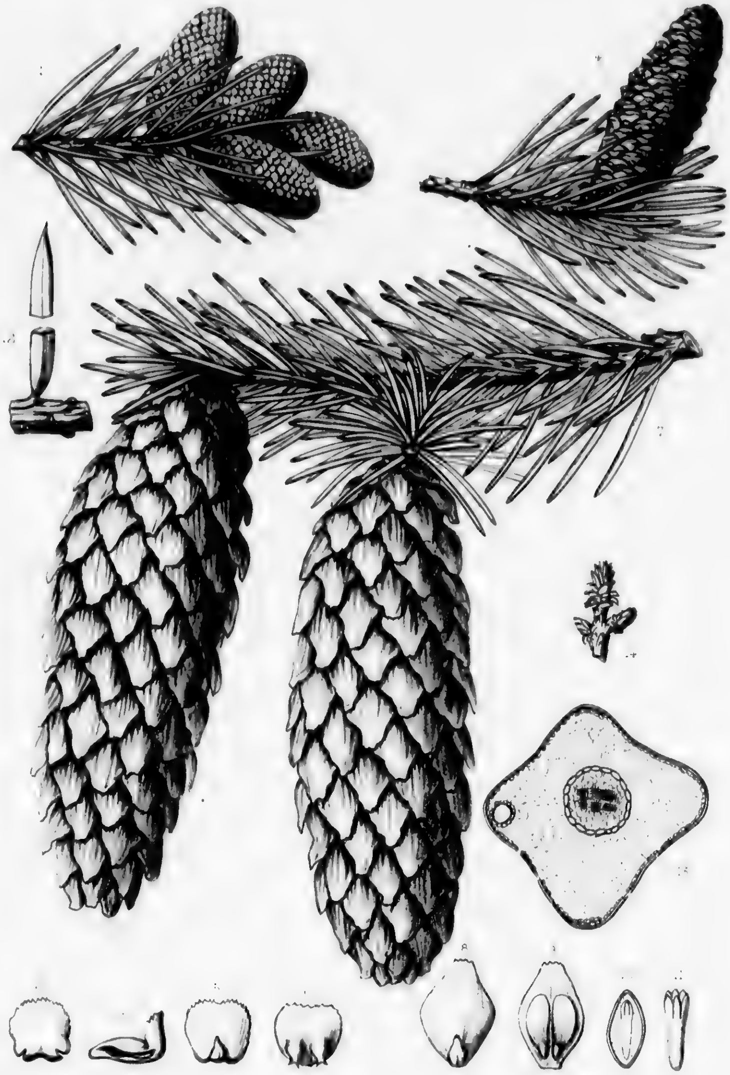
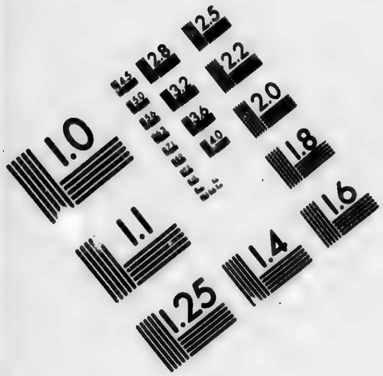
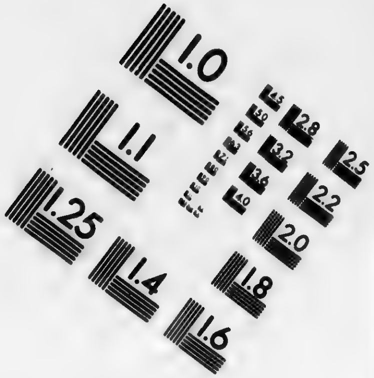
4. A branch with pistillate flowers, natural size.
5. A scale of a pistillate flower, lower side, with its bract, enlarged.
6. A scale of a pistillate flower, upper side, with its ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. Vertical section of a seed, enlarged.
11. An embryo, enlarged.
12. A leaf, [illegible] enlarged.
13. Cross-section of a leaf, magnified [illegible]
14. Winter buds, natural size.



PICEA PARRYANA, Sar.





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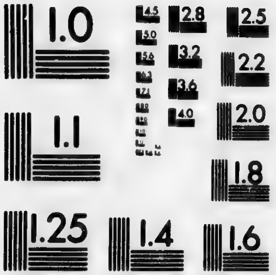

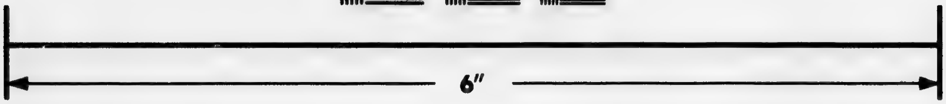

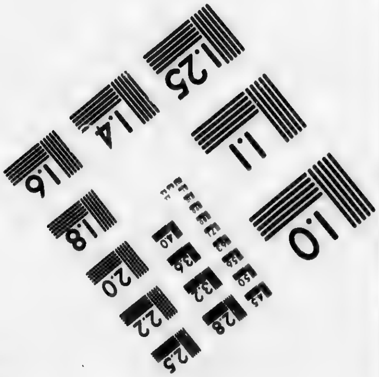

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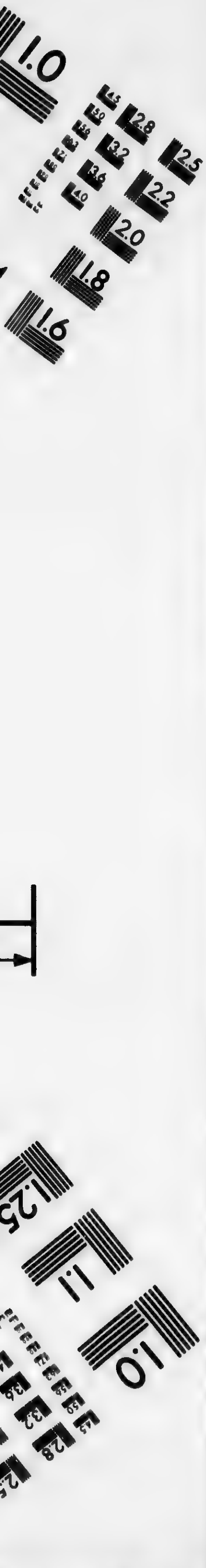
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PICEA BREWERIANA.

Weeping Spruce.

Cones oblong, acute, their scales rounded, entire. Branchlets slender, elongated, pendent, pubescent. Leaves flattened, stomatiferous only on the upper surface.

Picea Breweriana, Watson, *Proc. Am. Acad.* xx. 378 (1885). — Sargent, *Gard. Chron.* n. ser. xxv. 498, f. 93; *Garden and Forest*, ii. 496; iii. 63, f. 15, 16. — Mayr, *Wald. Nordam.* 355. — Lemmon, *Rep. California State Board Forestry*, iii. 116, t. 4–6 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 52; *Bull. Sierra Club*, ii. 158 (*Conifers of the Pacific Slope*). — Beissner, *Handb. Nadelh.* 350. — Masters, *Jour. R. Hort. Soc.* xiv. 221. — St. Paul, *Mitt. Deutsch. Dendr. Gesell.* 1895, 42, t.

A tree, usually from eighty to one hundred and occasionally one hundred and twenty feet in height, with a trunk from two to three feet in diameter above the swelling of its enlarged and gradually tapering base, and furnished to the ground with crowded branches; at the top of the tree these are short and slightly ascending, with comparatively short pendulous lateral branchlets, and form a thin spire-like head, and below they are horizontal or pendulous, and are clothed with slender flexible whip-like branchlets which are often seven or eight feet in length and not more than a quarter of an inch in thickness, and are furnished with numerous laterals of the same character and habit. The bark of the trunk is from one half to three quarters of an inch in thickness and is broken into long thin closely appressed scales which are dull red-brown on the surface. The winter-buds are conical, often a quarter of an inch long and an eighth of an inch thick, with thin light chestnut-brown scales. When they first appear the branchlets are coated with fine pubescence, which generally does not disappear until their third season, and during their first autumn and winter they are rather bright red-brown, and then gradually grow dark gray-brown. The leaves are abruptly narrowed and obtuse at the apex, straight or slightly incurved, rounded or obscurely ridged and dark green and lustrous on the lower surface, flattened and conspicuously marked on the upper surface with four or five rows of small stomata on each side of the prominent midrib, from three quarters of an inch to an inch and one eighth in length and from one sixteenth to one tenth of an inch in width. The staminate flowers are oblong, about five eighths of an inch long and a quarter of an inch thick, and dark reddish purple, with conspicuously toothed anther crests. The pistillate flowers are oblong-cylindrical, obtuse, and an inch in length, with obovate scales rounded above and reflexed on the entire margins, and oblong bracts laciniately divided at their rounded or acute apex. The cones are oblong, gradually narrowed from the middle to both ends, acute at the apex, rather oblique at the base, from two and a half to five inches in length and from three quarters of an inch to an inch in thickness, with thin broadly obovate flat scales longer than they are broad and slightly thickened on the entire margins; suspended on straight slender stalks about a quarter of an inch long, when fully grown the cones are deep rich purple or green more or less tinged with purple, and at maturity they are light orange-brown without lustre, and, opening late in the autumn, usually remain on the branches until the second winter, the scales becoming often strongly reflexed and so flexible that they can be easily compressed between the fingers. The seeds are acute at the base, full and rounded on the sides, about an eighth of an inch long, very dark brown and about one quarter the length of their wings, which are broadest toward the full and rounded apex.

Picea Breweriana is scattered in small groves through an area of a few hundred acres of dry mountain ridges and peaks near the timber-line on the northern slope of the Siskiyou Mountains, at an elevation of about seven thousand feet above the sea, at the head of one of the small south forks of the

Illinois River and just south of the northern boundary of California, where it was discovered[1] in June, 1884, by Mr. Thomas Howell.[2] There is a grove also a few miles farther south on the head-waters of a small northern tributary of the Klamath River and on the southern slope of the Siskiyou Mountains at an elevation of seven thousand five hundred feet.[3] This tree covers a mile square of mountain side at the head of Elk Creek, a tributary of the Klamath, on a high peak just west of Marble Mountain, in Siskiyou County, California, where it was discovered in 1897.[4] It grows on the Oregon coast ranges on the divide between Cañon Creek and Fiddlers' Gulch at the head of one of the western forks of the Illinois River,[5] and on the eastern end of the Chetco Range at elevations of between four and five thousand feet above the sea.[6] In Oregon it grows also on the north slopes of the Siskiyou Mountains on Sucker Creek, and on high mountain-tops south of Rogue River.[7]

The wood of *Picea Breweriana*, which is considerably heavier than that of the other North American species of Picea, is soft, close-grained, and compact, with a satiny surface; it is light brown or nearly white, with thick hardly distinguishable sapwood, and contains numerous thin medullary rays, broad widely scattered conspicuous resin passages, and broad and conspicuous bands of small summer cells.[8] The specific gravity of the absolutely dry wood is 0.5141, a cubic foot weighing 32.04 pounds.[9]

Picea Breweriana most resembles in leaf structure and in the form of its cone-scales the flat-leaved *Picea Omorika* of the Balkan peninsula, the least known of European conifers, as this Weeping Spruce is the most imperfectly known conifer of North America. Already less widely scattered and less multiplied than any other Spruce-tree, it seems destined soon to perish by fire, which has no doubt confined it to the few isolated and inaccessible mountain peaks where it has found its last resting-place.[10] In its specific name this beautiful tree, which differs from all other Spruces in its long pendent flexible branches, commemorates the services rendered by Professor William H. Brewer[1] to American dendrology.

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[1] The real discoverer of *Picea Breweriana* was probably Professor William H. Brewer, who, in 1863, found a Spruce-tree with long pendulous branchlets on Black Butte to the north of Strawberry Valley, and at the western base of Mt. Shasta, California. (See Engelmann, *Brewer & Watson Bot. Cal.* ii. 122.) Efforts to rediscover this tree have failed, and it is only known from the leaves and branchlets collected by Professor Brewer, who did not find cones. The branchlets resemble those of *Picea Breweriana* in their pubescent covoring, and the leaves are undistinguishable from those of this species. If the surmise that the tree discovered by Brewer in 1863 is *Picea Breweriana* is correct, Black Butte would be the most southern station known for this species, which would have a range north and south of nearly one hundred miles.

[2] Thomas Howell (October 9, 1842) was born in Cooper County, Missouri, and was the youngest of the five children of Dr. Benjamin Howell, the descendant of a Welsh family which had early settled in New Jersey, and a mineralogist of some reputation. Dr. Howell, with his family, left Missouri in 1850, crossed the plains with an ox-team to Oregon, and settled on Sauvie's Island in the Columbia River on one of the donation land-claims which then were given by the government to citizens of the United States in order to encourage American emigration to Oregon. A self-educated man, as schools were few and far between in the Oregon of fifty years ago, Mr. Howell manifested a strong love for plants from his early boyhood, although he did not begin the study of botany until 1877. In 1881 he published a list of all the flowering plants of Oregon, Washington, and Idaho. This was followed in 1887 by a catalogue and check-list of all the plants then known to occur in Oregon, Washington, and Idaho, and embracing 2,152 species and 227 varieties. In 1897 he began the publication of a *Flora of Northwest America*, covering the same territory, and not yet completed. Fifty plants new to science discovered by Mr. Howell testify to his activity and success as a field botanist. His name is commemorated in twenty-eight species and one genus of his discovery.

[3] This small grove of scattered trees was found on the watershed of the Klamath in September, 1885, by Mr. T. S. Brandegee. This is probably the most accessible station of this tree. It can be reached in a day from Waldo, in Josephine County, Oregon, by following the Happy Camp Trail, which crosses the Siskiyou Mountains from the waters of the Illinois River to those of the Klamath, and then taking one which near the summit leaves it for Big Meadows; this place is about four miles to the westward of the point where the summit of the Siskiyou is crossed, and beyond it the trail passes close to the trees.

[4] Jepson, *Erythea*, vi. 12.

[5] T. H. Douglas, *Garden and Forest*, v. 591, f. 102. See, also, *Garden and Forest*, v. 506.

[6] *Teste* A. J. Johnson.

[7] *Teste* A. J. Johnson. The station above Rogue River valley, which was discovered by Mr. Johnson in 1896, is about fifty miles north of the Siskiyou Mountains.

[8] Probably *Picea Breweriana* is a slow-growing tree, the log specimen cut by Mr. Brandegee in 1885, near Big Meadows, for the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is thirteen and a quarter inches in diameter inside the bark and one hundred and sixty-six years old. The sapwood, which is hardly distinguishable from the heartwood, is three inches and seven sixteenths in diameter, with sixty-one layers of annual growth.

[9] Sargent, *Garden and Forest*, iii. 356.

[10] Fires are prevalent and very destructive in all the dry mountain region which forms the natural boundary between northwestern California and southeastern Oregon, and which is now probably the only home of *Picea Breweriana*. They have already done incalculable damage to the forests of this region and are increasing every year in frequency and destructiveness as the number of

settlers and of miners and mine prospectors increases. It seems hopeless, therefore, to expect that the few isolated trees of this species can long escape their ravages.

The danger of the extermination of *Picea Breweriana* is heightened by the fact that it has proved difficult to raise artificially. Several hundred thousand seedlings were grown by Mr. Robert Douglas of Waukegan in 1891, but they all gradually perished during their first and second years. An attempt to raise this tree on a large scale in the Arnold Arboretum from seeds has been equally unsuccessful, and all efforts to carry the seedlings through their early stages have failed in England. Mr. A. J. Johnson has transferred a few small trees from the Siskiyou Mountains to his nursery at Astoria, Oregon, where they are now growing thriftily; and some of these plants are also flourishing in gardens near Portland, Oregon.

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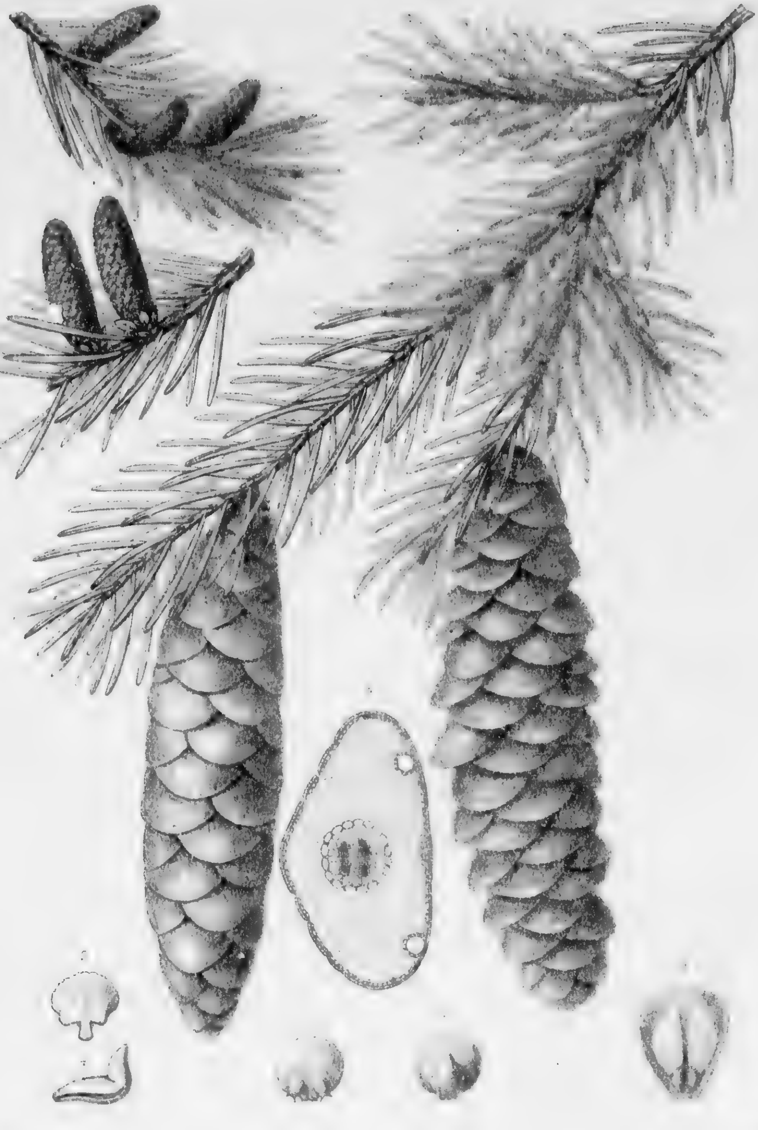
[1] See viii. 28.

EXPLANATION OF THE PLATE.

PLATE DCI. PICEA BREWERIANA.

1. A branch with staminate flowers, natural size.
2. An anther, front view, enlarged.
3. An anther, side view, enlarged.
4. A branch with pistillate flowers, natural size.
5. A scale of a pistillate flower, upper side, with its ovules, enlarged.
6. A scale of a pistillate flower, lower side, with its bract, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, upper side, with its seeds, natural size.
9. Cross section of a leaf magnified fifteen diameters.

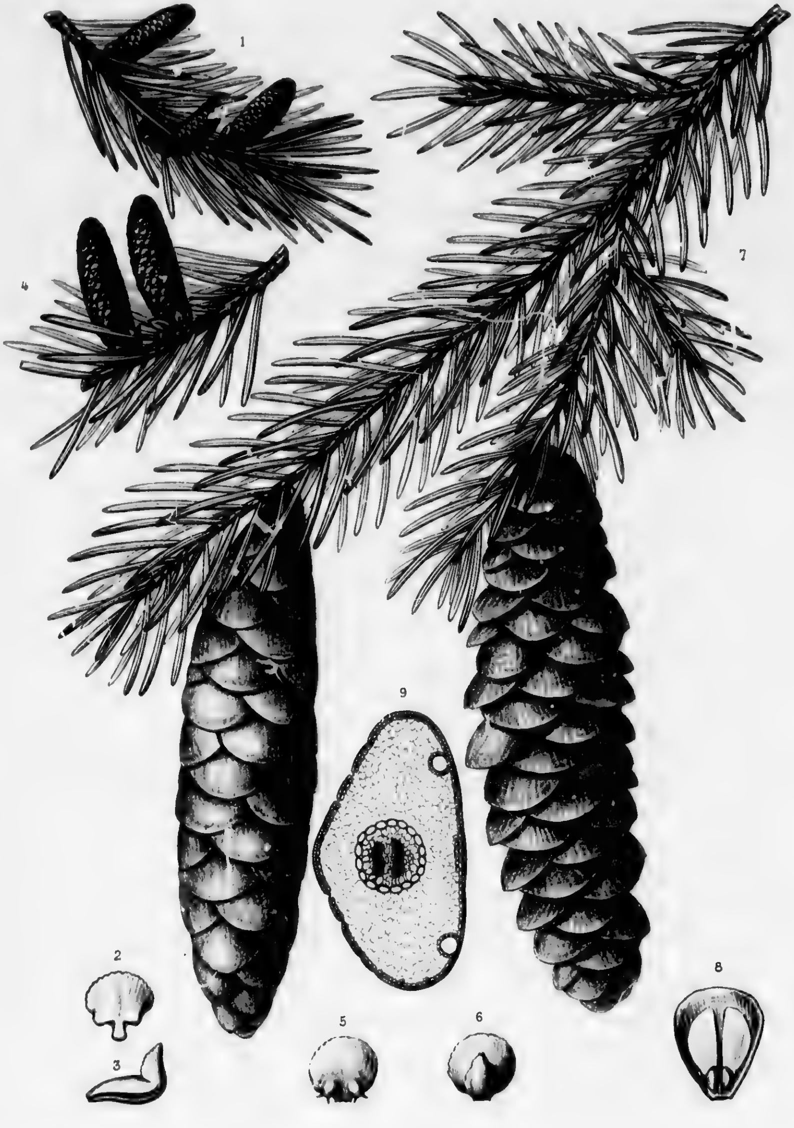


PICEA BREWERIANA

EXPLANATION OF THE PLATE

Plate DCI. Picea Breweriana.

1. A branch with staminate flowers, natural size.
2. An anther, front view, enlarged.
3. An anther, side view, enlarged.
4. A branch with pistillate flowers, natural size.
5. A scale of a pistillate flower, upper side, with its ovules, enlarged.
6. A scale of a pistillate flower, lower side, with its bract, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, upper side, with its seeds, natural size.
9. Cross section of a leaf magnified fifteen diameters.



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PICEA SITCHENSIS.

Tideland Spruce. Sitka Spruce.

CONES cylindrical-oval, their scales oblong-oval, rounded and denticulate above the middle. Branchlets glabrous. Leaves flattened, acute or acuminate, silvery white and stomatiferous on the upper surface, often slightly stomatiferous below.

Picea Sitchensis, Carrière, *Traité Conif.* 260 (1855). — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 85. — Engelmann, *Gard. Chron.* n. ser. xi. 344; *Brewer & Watson Bot. Cal.* ii. 122. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 206. — Mayr, *Wald. Nordam.* 338. — Lemmon, *Rep. California State Board Forestry*, iii. 115, t. 3 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 52; *Bull. Sierra Club*, ii. 157 (*Conifers of the Pacific Slope*). — Beissner, *Handb. Nadelh.* 390, f. 105. — Masters, *Jour. R. Hort. Soc.* xiv. 224. — Herder, *Act. Hort. Petrop.* xii. 113 (*Pl. Radd.*). — Koehne, *Deutsche Dendr.* 24. — Hempel & Wilhelm, *Bäume und Sträucher*, i. 85, f. 43.

Pinus Sitchensis, Bongard, *Vég. Sitcha*, 46 (August, 1832); *Mém. Phys. Math. Nat.* pt. ii. *Acad. Sci. St. Pétersbourg*, ii. 164. — Hooker, *Fl. Bor.-Am.* ii. 164. — Antoine, *Conif.* 98. — Endlicher, *Syn. Conif.* 123. — Ledebour, *Fl. Ross.* iii. 672. — Dietrich, *Syn.* v. 395.

Abies trigona, Rafinesque, *Atlant. Jour.* 119 (Autumn, 1832); *New Fl.* i. 37. — Endlicher, *Syn. Conif.* 124.

Abies falcata, Rafinesque, *Atlant. Jour.* 120 (Autumn, 1832); *New Fl.* i. 38. — Endlicher, *Syn. Conif.* 127. — Carrière, *Traité Conif.* 268.

Abies Menziesii, Lindley, *Penny Cycl.* 1, 32 (1833). — Lawson & Son, *Agric. Man.* 378. — Forbes, *Pinetum Woburn.* 93, t. 32. — Nuttall, *Sylva*, iii. 131, t. 116. — Knight, *Syn. Conif.* 37. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 211. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 56, 90, f. 21, t. 9. — Gordon, *Pinetum*, 6. — Cooper, *Pacific R. R. Rep.* xii. pt. ii. 25, 69 (in part). — Lyall, *Jour. Linn. Soc.* vii. 131, 133, 143. — Henkel & Hochstetter, *Syn. Nadelh.* 187. — (Nelson) Senilis, *Pinaceæ*, 48. — Hoopes, *Evergreens*, 166 (in part). — Watson, *King's Rep.* v. 333 (in part). — Veitch, *Man. Conif.* 73. — Schübeler, *Virid. Norveg.* i. 431.

Pinus Menziesii, D. Don, *Lambert Pinus*, iii. t. (1837). — Hooker, *Fl. Bor.-Am.* ii. 162. — Antoine, *Conif.* 85, t. 33, f. 1. — Hooker & Arnott, *Bot. Voy. Beechey*, 394. — Endlicher, *Syn. Conif.* 112. — Lawson & Son, *List No. 10, Abietineæ*, 15. — Dietrich, *Syn.* v. 394. — Courtin, *Fam. Conif.* 61. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 418.

Pinus Menziesii, var. crispa, Antoine, *Conif.* 86, t. 35, f. 2 (1840–47).

Abies Sitchensis, Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 212 (1850). — K. Koch, *Dendr.* ii. pt. ii. 247 (excl. syn.). — Lauche, *Deutsche Dendr.* ed. 2, 93.

Picea Menziesii, Carrière, *Traité Conif.* 237 (1855). — Masters, *Gard. Chron.* n. ser. xxv. 728, f. 161, 162. — Willkomm, *Forst. Fl.* ed. 2, 98.

Picea Menziesii, var. crispa, Carrière, *Traité Conif.* 237 (1855). — Hoopes, *Evergreens*, 168.

Picea Ajanensis, Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 85 (not Trautvetter & Meyer) (1874).

Tsuga Sitchensis, Regel, *Russ. Dendr.* ed. 2, pt. i. 40 (1883).

Picea Sitkænsis, Wittstein, *Sitz. Math.-nat. Akad. Wiss. Wien*, xcix. pt. i. 528 (1891).

A tree, usually about a hundred feet in height, with a conspicuously tapering trunk which is often three or four feet in diameter above its strongly buttressed and much enlarged base, the Tideland Spruce is occasionally two hundred feet or more tall, with a trunk fifteen or sixteen feet in diameter, and at the extreme northwestern limits of its range it is sometimes reduced to a low shrub.[1] The branches of young trees are slender and horizontal, with rigid leading shoots, and are set close together on the stem, forming a rather loose open pyramid; on older trees the lower branches, which are thickly clothed with pendent slender lateral branchlets frequently two or three feet long, sweep out in long graceful curves; the upper branches are short, and, ascending, form an open spire-like head which surmounts a stem often naked for half its length or is frequently covered to the ground with branches which are occasionally thirty or forty feet long on trees which have grown in open situations.

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[1] A good idea of the enlarged and buttressed base of a large trunk of *Picea Sitchensis*, and of the bark of this species, here wrongly called the Douglas Fir, is published on page 211 of the fourth volume of *Garden and Forest*.

The bark of the trunk is from one quarter to one half of an inch in thickness, and is broken on the surface into large thin loosely attached dark red-brown or, on young trees, sometimes bright cinnamon-red scales. The winter-buds are ovate and acute or conical and from one quarter to nearly one half of an inch in length, with pale chestnut-brown lustrous scales which are ovate, acute and sometimes tipped with short mucros, scarious on the margins and often more or less reflexed above the middle. The branchlets are stout, rigid, glabrous and pale green when they first appear, becoming light or dark orange-brown during their first autumn and winter, and then gradually turn dark gray-brown. The leaves stand out from all sides of the branches, often nearly at right angles to them, and frequently bring their white upper surface to view by a twist at their base, and are straight or slightly incurved, acute or acuminate, with elongated callous tips; they are slightly rounded on the lower surface, which is green and lustrous and occasionally marked, especially on the leaves of leading shoots and fertile branches, with two or three rows of small inconspicuous stomata on each side of the prominent midrib, and on the upper surface they are flattened, obscurely ridged, and almost covered with broad silvery white bands of numerous rows of stomata; in length they vary from half an inch on fertile branches to an inch and an eighth on vigorous lower branches and in width from one sixteenth to one twelfth of an inch. The staminate flowers are produced in great quantities toward the ends of the pendent lateral branchlets, and are oblong-cylindrical, dark red, short-stalked, surrounded at the base by the much enlarged bud-scales which form conspicuous involucres around both the male and female flowers, from three quarters of an inch to an inch and a half in length and often half an inch in thickness. The pistillate flowers are borne on the rigid terminal shoots of the branches of the upper half of the tree and are oblong-cylindrical, about an inch long and half an inch thick, with nearly orbicular denticulate scales often slightly truncate above and completely hidden by their elongated acuminate bracts. The cones hang on short straight stalks and are cylindrical-oval, usually from two and a half to four inches in length and from an inch to an inch and a half in thickness, with thin stiff oblong-oval scales rounded toward the apex, denticulate above the middle and nearly twice as long as their lanceolate denticulate rigid bracts; when fully grown at midsummer the cones are yellow-green, often tinged with dark red, especially on the side exposed to the sun, and at maturity they are lustrous, pale yellow or reddish brown, and fall mostly during their first autumn and winter and soon after the escape of the seeds. These are full and rounded, acute at the base, pale reddish brown, and about an eighth of an inch long, with narrow oblong only slightly oblique wings from one half to one third of an inch in length, and four or five cotyledons which are three-sided, the two upper sides being concave and stomatiferous and the lower rounded.

Picea Sitchensis usually inhabits moist sandy and often swampy soil, or, less frequently at the far north, wet rocky slopes. Maintaining itself farther to the northwest than any other coniferous tree of the Pacific forests, *Picea Sitchensis* forms groves on the eastern end of Kadiak Island in longitude 151° west, and extends southward through all the coast region of Alaska[1] and British Columbia west of the coast ranges,[2] and through western Washington and Oregon to Mendocino County in California.[3] Small and stunted, and sometimes only a shrub toward the extreme northwestern limits of its range, it becomes on the coast of southeastern Alaska, where its principal companion is the western Hemlock, the largest and most abundant tree in this part of the great coniferous forest which stretches from Cross Sound to Cape Mendocino, growing at the sea-level often to a height of more than a hundred feet and ascending to elevations of three thousand feet, but decreasing in size as it ascends or leaves the immediate neighborhood of the ocean.[4] Very abundant in the northern coast region of British

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[1] Rothrock, *Smithsonian Rep.* 1867, 433, 455 (*Fl. Alaska*). — Meehan, *Proc. Phil. Acad.* xix. 92. — F. Kurtz, *Bot. Jahrb.* xix. 425 (*Fl. Chilcatgiebetes*). — Funston, *Contrib. U. S. Nat. Herb.* iii. 328.

[2] G. M. Dawson, *Can. Nat.* n. ser. ix. 326. — Macoun, *Cat. Can. Pl.* 470.

[3] The most southern point from which I have seen specimens of *Picea Sitchensis* is Caspar, on the coast of Mendocino County, California. The cones from this locality are the smallest I have seen, being only an inch and a half long.

[4] See Gorman, *Pittonia*, iii. 67.

Columbia, farther south it is principally confined to the low sandy alluvial plains at the mouths of streams, on which, mingling with the western Arbor Vitæ, it grows to its largest size along the coast of Washington and Oregon, and to moist bottom-lands which it follows inland to the foothills of the Cascade Mountains of Washington and northern Oregon, sometimes ascending on the Nisqually and other streams which flow into Puget Sound to elevations of two thousand feet above the sea. South of the valley of the Columbia River it is confined to the neighborhood of the coast, and although the Tideland Spruce grows in northern California to a very large size on the rich alluvial plains at the mouths of streams and in low valleys facing the ocean, where it is associated with the Redwood and the White Fir, it is less common and of less magnificent proportions than on the shores of Puget Sound. South of Cape Mendocino it is not common.

The wood of *Picea Sitchensis* is light, soft, not strong, and straight-grained, with a satiny surface; it is light brown tinged with red, with thick nearly white sapwood, and contains numerous prominent medullary rays, few resin passages, and inconspicuous narrow bands of small summer cells. The specific gravity of the absolutely dry wood is 0.4287, a cubic foot weighing 26.72 pounds. It is the principal lumber manufactured in Alaska, where, as it splits easily, it is also largely used for fuel. It is manufactured into lumber on Puget Sound, and is used in construction, in the interior finish of buildings, for fencing, for the dunnage of vessels, in boatbuilding and cooperage, and for woodenware and packing-cases.

Picea Sitchensis was discovered on the shores of Puget Sound in May, 1792,[1] by Archibald Menzies,[2] the surgeon and naturalist of Vancouver, during his voyage of discovery round the world, although it was not described until forty years later. It was introduced into European gardens in 1831[3] by David Douglas,[4] and has already grown to a large size in several of the countries of western and central Europe.[5] In the eastern United States it suffers from the cold of severe winters and from heat and drought in summer, and rarely survives more than a few years.

The greatest of all Spruce-trees, this inhabitant of the northwest coast is surpassed by few other trees in thickness and height of stem. No tree in the American forest grows with greater vigor or shows stronger evidences of vitality,[6] and there are few more beautiful and impressive objects in the forests of temperate North America than one of these mighty Spruce-trees with its spire-like head raised high above its broad base of widely sweeping and gracefully upturned branches resting on the surface of the ground, its slender branchlets loaded with handsome cones nodding in the slightest breeze, and its leaves, now silvery white and now dark and lustrous, shimmering in the sunlight.

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[1] The "Norwegian Hemlock" mentioned by Vancouver among the trees he saw when he landed on the shore of Puget Sound was probably this Spruce (*A Voyage of Discovery to the Northern Pacific Ocean and Around the World*, i. 249). It was well described in the journal of Lewis and Clark, who passed the winter of 1806 at the mouth of the Columbia River, where *Picea Sitchensis* is abundant, and who saw a specimen "forty-two feet in circumference, at a point beyond the reach of an ordinary man. This trunk for the distance of two hundred feet was destitute of limbs; the tree was perfectly sound, and at a moderate calculation its stature may be estimated at three hundred feet" (*Narrative of the Expedition under Command of Lewis and Clark*, ed. Coues, iii. 829).

[2] See ii. 90.

[3] Loudon, *Arb. Brit.* iv. 2321, f. 2232.

[4] See ii. 94.

[5] M'Laren, *Trans. Scottish Arboricultural Society*, x. 212. — Webster, *Trans. Scottish Arboricultural Society*, xi. 57. — Dunn, *Jour. R. Hort. Soc.* xiv. 84. — Hansen, *Jour. R. Hort. Soc.* xiv. 438 (*Pinetum Danicum*). — J. G. Jack, *Garden and Forest*, vi. 14. See, also, R. Hartig. *Forst.-Nat. Zeit.* i. 428.

[6] On the shores of Puget Sound young trees often make leading shoots from three to four feet in length; and so vigorous is the growth of this Spruce in the humid coast region of the northwest that the lateral branchlets sometimes develop into small trees and stand erect on the branches of large individuals. Of three trees measured by John Muir, at Wrangel, Alaska, one was seven hundred and sixty-four years old, with a trunk five feet in diameter; the second was five hundred years old, with a trunk six feet three inches in diameter; and the third was three hundred and eighty-five years old, with a trunk four feet in diameter. A tree measured by him, which had grown on the edge of a meadow on the Snoqualmie River in Washington, was one hundred and eighty feet high, with a trunk four feet six inches in diameter, and was two hundred and forty years old. Another tree, also measured by him near the city of Vancouver, in British Columbia, was only forty-eight years old, but had a trunk three feet in diameter. Of two trees examined by Gorman in Alaska (*Pittonia*, iii. 67), No. 1, cut on the mainland, was one hundred and sixty feet tall, with a trunk diameter of three feet eleven inches, and was two hundred and seventy-seven years old, while No. 2, cut on Hassler Island, had a trunk four feet and half an inch in diameter fourteen feet above the surface of the ground, and was four hundred and thirty-four years old. The first had grown in dense woods, well protected from the wind, and the second on a hillside exposed to fierce northeast gales in autumn and winter. The heart of the latter was thirty-two inches from the southwest side and only sixteen and one half inches from the northeast side.

EXPLANATION OF THE PLATE.

PLATE DCII. PICEA SITCHENSIS.

1. A branch with staminate flowers, natural size.
2. An anther, front view, enlarged.
3. An anther, side view, enlarged.
4. A branch with pistillate flowers, natural size.
5. A pistillate flower, natural size.
6. A scale of a pistillate flower, lower side, with its bract, enlarged.
7. A scale of a pistillate flower, upper side, with its ovules, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, lower side, with its bract, enlarged.
10. A cone-scale, upper side, with its seeds, enlarged.
11. Vertical section of a seed, enlarged.
12. An embryo, enlarged.
13. A leaf divided transversely, enlarged.
14. Cross section of a leaf magnified fifteen diameters.
15. A seedling plant, natural size.
16. Winter-buds, natural size.

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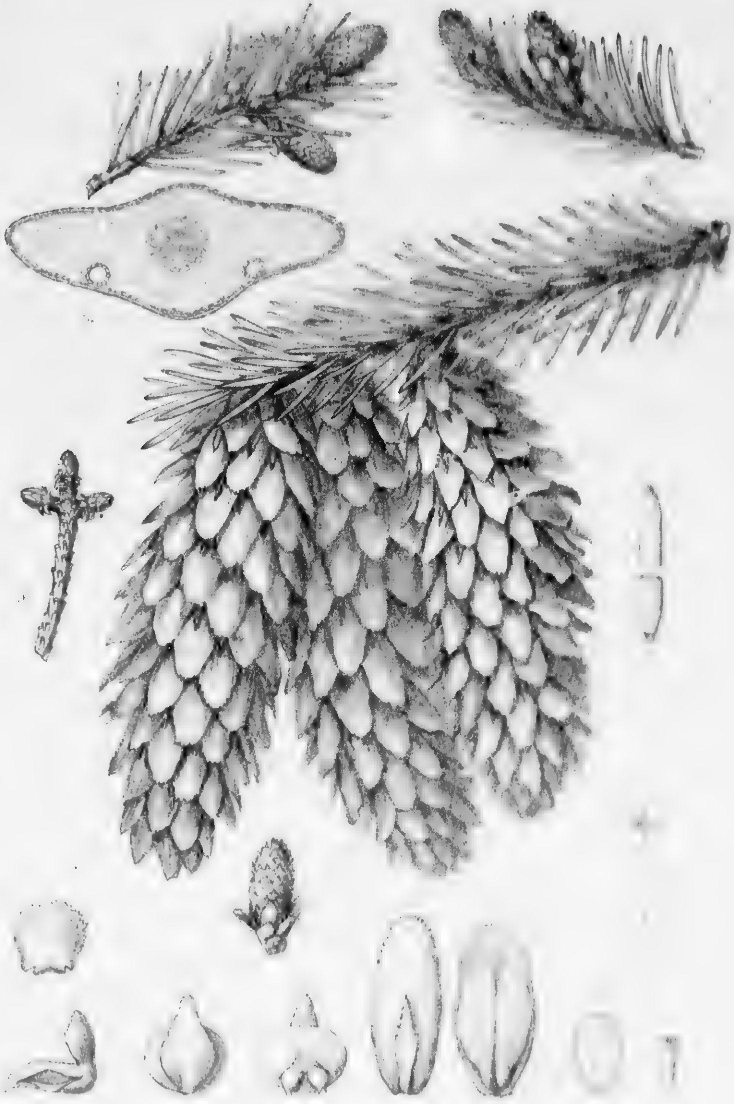

[illegible] sweeping and gracefully upturned branches resting on the [illegible] branchlets loaded with handsome cones nodding in the slightest [illegible] white and now dark and lustrous, shimmering in the sunlight.

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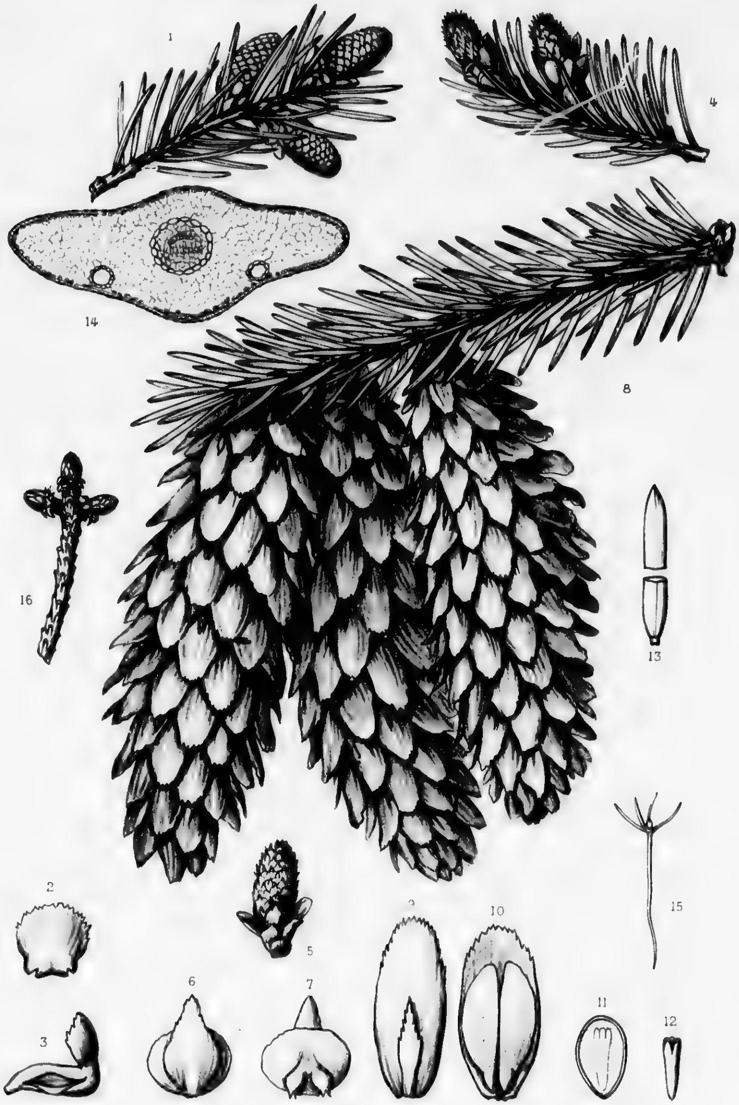

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PICEA SITCHENSIS, Carr.

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TSUGA.

Flowers solitary, naked, monœcious; the staminate axillary, stamens indefinite, anther-cells 2, transversely dehiscent, surmounted by gland-like tips; the pistillate terminal, ovules 2 under each scale. Fruit a woody strobile maturing in one season; seeds furnished with resin vesicles. Leaves petiolate, persistent.

Tsuga, Carrière, *Traité Conif.* 185 (1855). — Engelmann, *Trans. St. Louis Acad.* ii. 211 (excl. sect. Peucoides). — Bentham & Hooker, *Gen.* iii. 440. — Eichler, *Engler & Prantl. Pflanzenfam.* ii. pt. i. 80 (in part). — Masters, *Jour. Linn. Soc.* xxx. 28.

Abies, A. L. de Jussieu, *Gen.* 414 (in part) (1789). — Link, *Abhand. Akad. Berl.* 1827, 181 (in part).

Pinus, Endlicher, *Gen.* 260 (in part) (1836). — Meisner, *Gen.* 352 (in part). — Baillon, *Hist. Pl.* xii. 44 (in part) (1892).

Hesperopeuce, Lemmon, *Rep. California State Board Forestry*, iii. 111 (*Cone-Bearers of California*) (1890). — Van Tieghem, *Bull. Soc. Bot. France*, sér. 2, xiii. 414.

Tall pyramidal trees, with thick deeply furrowed astringent bark, bright cinnamon-red except on the surface, soft pale wood, elongated nodding leading shoots, slender scattered horizontal often pendulous branches with laterals three or four times irregularly pinnately ramified, the ultimate divisions slender, terete, glabrous, or pubescent, the whole forming broad flat gracefully pendent masses of foliage. Buds ovate, acute, minute, covered by closely imbricated dark chestnut-brown lustrous scales, the two outer minute, lateral, opposite, those of the inner ranks scarious, accrescent, early deciduous. Leaves flat or angular, obtuse and often emarginate or acute at the apex, spinulose-denticulate or entire, spirally arranged round the branch, appearing approximately two-ranked by the twisting of their petioles, those on the upper side of the branch then usually much shorter than the others, or in one species not distichous and of nearly equal length, narrowed abruptly into short petioles closely pressed against the stem and articulate on prominent and ultimately ligneous persistent bases, containing a single dorsal resin duct between the midrib and epidermis,[1] stomatiferous only on the lower or in one species on both surfaces, persistent, but soon deciduous in drying. Flowers naked, monœcious, solitary, appearing in early spring before the leaves from buds formed the previous summer and covered by numerous chestnut-brown scales, those of the inner ranks chaff-like, persistent, and forming involucres at the base of the flowers. Staminate flowers in the axils of leaves of the previous year near the ends of the branchlets, subglobose, raised on elongated slender drooping stems, composed of numerous spirally arranged short-stalked two-celled subglobose anthers opening transversely, their connectives produced above the cells into short gland-like tips; pollen-grains discoid or bilobed.[2] Pistillate flowers terminal, short-stalked, or subsessile, erect, composed of spirally arranged nearly circular scales bearing on their inner face near the base two naked collateral inverted ovules, rather shorter than or as long as their membranaceous acute bracts. Fruit an ovate oblong, oval or oblong-cylindrical obtuse pendulous or rarely erect short-stalked or sessile cone maturing in one season, composed of concave loosely imbricated woody obovate-oblong or suborbicular scales, decreasing in size and sterile toward both ends of the cone, thin and entire on the margins, much longer than their minute bracts, persistent on the central axis of the cone after the escape of the seeds. Seeds geminate, reversed, attached at the base in shallow depressions on the inner base of the scales, ovate-oblong, compressed, in falling bearing away portions of the membranaceous lining of the scale forming obovate-oblong wing-like attachments longer than the seeds and nearly surrounding them; testa of two coats, the outer crustaceous, light brown, the inner membranaceous, pale chestnut-brown and lustrous. Embryo axile in conspicuous fleshy albumen; cotyledons from three to six, stomatiferous on the upper surface, much shorter than the inferior radicle.[1]

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[1] In the single species with rounded acute leaves the resin canal is separated from the midrib by a few cells, while in the flat-leaved Tsugas the resin canal occupies nearly the whole space between the midrib and the epidermis. (See Van Tieghem, *Bull. Soc. Bot. France*, sér. 2, xiii. 414.)

[2] Engelmann, *Brewer & Watson Bot. Cal.* ii. 120.

The genus Tsuga is now confined to temperate North America and to eastern and southern Asia, seven species being distinguished. In North America two species occur in the eastern part of the continent and two in the western; in Japan *Tsuga diversifolia*[2] forms forests at high elevations in central and northern Hondo, and *Tsuga Araragi*[3] is scattered over the southern mountains; and over the high inner ranges of the eastern Himalayas *Tsuga dumosa*[4] is widely distributed. The

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[1] The species of Tsuga may be grouped in two sections: —

MICROPEUCE (Spach, *Hist. Vég.* xi. 424 [1842]. — *Eutsuga*, Engelmann, *Brewer & Watson Bot. Cal.* ii. 120 [1880]). Leaves flat, obtuse, stomatiferous only on the lower surface, appearing two-ranked by the twisting of their petioles, of two lengths; cones ovate-oblong, fertile scales few.

HESPEROPEUCE, Engelmann, *l. c.* 121 (1880). Leaves rounded or keeled above, acute, stomatiferous on both surfaces, their petioles slightly or not at all twisted; cones oblong-cylindrical, fertile scales numerous.

[2] Masters, *Jour. Linn. Soc.* xviii. 514 (*Conifers of Japan*) (1881); *Jour. R. Hort. Soc.* xiv. 255. — Mayr, *Monog. Abiet. Jap.* 61, t. 4, f. 13. — Beissner, *Handb. Nadelh.* 396. — Koehne, *Deutsche Dendr.* 11. — Sargent, *Garden and Forest*, x. 491, f. 63.

Abies diversifolia, Maximowicz, *Bull. Acad. Sci. St. Pétersbourg*, xii. 229 (1868) (*Mél. Biol.* vi. 373). — Franchet & Savatier, *Enum. Pl. Jap.* i. 468.

Tsuga diversifolia is a tree seventy or eighty feet in height, with a short trunk often three or four feet in diameter, dark red deeply furrowed bark, very slender branchlets covered with rufous pubescence, short narrow emarginate leaves, and cones, which are rarely more than half an inch in length. On the Nikkō and other high mountains of central Japan, it is the principal tree in great forests which extend from elevations of about five thousand feet above the level of the sea nearly to the upper limits of tree-growth, its most northerly home in Japan being on the mountains which surround the Bay of Aomori. (See Sargent, *Forest Fl. Jap.* 81, t. 25.) The Hemlock found by Dr. Augustine Henry in the province of Hupeh in central China (No. 6907), although its leaves are rather longer, seems to be of this species. The woods produced by the two Japanese Hemlocks, which do not appear to be distinguished in commerce, are said to be hard, tough, and valuable. They are used only in the construction of expensive houses, and the remoteness and inaccessibility of the region where these trees grow make the transport of their wood difficult and expensive (Dupont, *Essences Forestières du Japon*, 17).

Tsuga diversifolia was discovered in 1860 on the slopes of Mt. Fugi-san by Mr. J. G. Veitch, the companion of Sir Rutherford Alcock in the first ascent of that mountain made by Europeans, although it was not distinguished from the other Japanese Hemlock until seven years later. (See J. G. Veitch, in Alcock, *The Capital of the Tycoon*, ii. Appx. E. 483.) Less commonly cultivated in the gardens of the United States and Europe than *T. Araragi*, it has proved perfectly hardy in New England, where, although still shrubby in habit, it has produced abundant crops of cones.

[3] Koehne, *l. c.* 10 (1893). — Sargent, *Garden and Forest*, x. 491, f. 62.

Pinus Araragi, Siebold, *Verhand. Batav. Genoot. Konst. Wet.* xii. 12 (1830).

Abies Tsuga, Siebold & Zuccarini, *Fl. Jap.* ii. 14, t. 106 (1842). — Gordon, *Pinetum*, 19. — Lindley, *Gard. Chron.* 1861, 23. — A. Murray, *The Pines and Firs of Japan*, 84, f. 159–171. — Maximowicz, *l. c.* 230 (*l. c.* 374). — Miquel, *Ann. Mus. Bot. Lugd. Bat.* iii. 167 (*Prol. Fl. Jap.*). — Franchet & Savatier, *l. c.* 468.

Abies Araragi, Loudon, *Encycl. of Trees*, 1036 (1842). — K. Koch, *Dendr.* ii. pt. ii. 249.

Pinus Tsuga, Antoine, *Conif.* 83, t. 32, f. 2 (1840–47). — Endlicher, *Syn. Conif.* 83. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 428.

Tsuga Sieboldii, Carrière, *Traité Conif.* 186 (1855). — Masters, *Jour. Linn. Soc.* xviii. 512 (*Conifers of Japan*). — Beissner, *l. c.* 394 f. 106.

Tsuga Tsuja, A. Murray, *Proc. R. Hort. Soc.* ii. 506, f. 141–153 (1862).

Picea (Tsuga) Sieboldii, Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 89 (1874).

Pinus Sieboldii, W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 213, t. 23, f. 6 (1875).

A species of more southern range and of lower elevations than *Tsuga diversifolia*, the second Japanese Hemlock, *Tsuga Araragi*, is found on the mountains of south central Hondo, usually in small scattered groves among deciduous-leaved trees or mixed with the Mountain Pine, *Pinus densiflora*. It is a beautiful tree, from sixty to eighty feet in height, with a trunk usually not more than two feet in diameter, covered with pale bark, drooping branches, lustrous orange-brown glabrous branchlets, leaves longer, broader, and more lustrous than those of *Tsuga diversifolia*, and cones nearly an inch in length. Introduced into Europe in 1853 by Von Siebold, it is occasionally found in European collections, appearing, however, less successful in them than in the eastern United States, where this Hemlock is one of the most graceful and satisfactory of the exotic conifers cultivated in American gardens, and where it promises to grow to a large size.

A dwarf bushy form of this tree with short branches and shorter and more crowded leaves, found by Von Siebold in Japanese gardens, has been introduced into those of the United States and Europe. It is

Tsuga Araragi, var. *nana*.

Pinus Tsuga, B *nana*, Endlicher, *l. c.* (1847). — Parlatore, *l. c.*

Tsuga Sieboldii, B *nana*, Carrière, *l. c.* (1855). — Beissner, *l. c.* 395.

Abies Tsuga nana, Gordon, *l. c.* Suppl. 13 (1862).

[4] *Tsuga dumosa*.

Pinus dumosa, D. Don, *Prodr. Fl. Nepal.* 55 (1825). — Lam-genus probably once occupied a more important position in northern forests, for traces of what are believed to be extinct species have been found in the Jurassic rocks of Spitzenberg, northern Europe, and Siberia.[1]

The bark of Tsuga is rich in tannin, and that of the American species is largely used in tanning leather, and occasionally in medicine. As a timber-tree the most valuable of the genus is *Tsuga heterophylla* of the northwest coast region of North America.

Tsuga is not injured by the attacks of many insects[2] or by numerous fungal diseases.[3]

All the species are cultivated for the decoration of parks and gardens, and no other conifers surpass the Hemlocks in grace and beauty. They can be easily raised from seeds, although the young plants grow slowly.

Tsuga, the Japanese name of the Hemlock-tree, was first used by Endlicher[4] to designate a section in his genus Pinus, and afterward by Carrière, who separated the Hemlocks into a generic group, as the name of his genus.

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bert, *Pinus*, ed. minor, ii. 80, t. 46. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 429.

Pinus Brunoniana, Wallich, *Pl. Asiat. Rar.* iii. 24, t. 247 (1832). — Antoine, *Conif.* 82, t. 32, f. 1. — Endlicher, *Syn. Conif.* 84. — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 213, t. 23, f. 5.

Abies Brunoniana, Lindley, *Penny Cycl.* i. 30, f. (1833). — Madden, *Jour. Agric. and Hort. Soc. Ind.* iv. pt. iv. 95 (*Himalayan Coniferæ*). — Gordon, *Pinetum*, 13.

Abies dumosa, Loudon, *Arb. Brit.* iv. 2325, f. 2233, 2234 (1838). — K. Koch, *Dendr.* ii. pt. ii. 252.

Abies species, Griffith, *It. Not.* ii. 141 (1848); *Icon. Pl. Asiat.* iv. t. 375 (Taxi on plate).

Tsuga Brunoniana, Carrière, *Traité Conif.* 188 (1855). — Masters, *Gard. Chron.* n. ser. xxvi. 500, f. 101. — Hooker f. *Fl. Brit. Ind.* v. 654. — Beissner, *Handb. Nadelh.* 397.

Picea (*Tsuga*) *Brunoniana*, Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 89 (1874).

Tsuga dumosa is distributed over the inner ranges of the Himalayas from Kumaon to Bhotan, at elevations of between eight thousand and ten thousand five hundred feet above the level of the sea, in Sikkim forming great forests with *Abies Webbiana*. It is a stately pyramidal tree, sometimes one hundred and twenty-five feet in height, with a trunk eight or nine feet in diameter, spreading branches, pendulous branchlets, and erect or horizontal cones. (See Hooker f. *Himalayan Journals*, n. ed. ii. 121; *Gard. Chron.* n. ser. xxvi. 72, f. 14.) The wood is white, tinged with pink, soft, and not durable; in Sikkim it is made into shingles, and the thick rough bark is employed for roofing (Brandis, *Forest Fl. Brit. Ind.* 527. — Gamble, *Man. Indian Timbers*, 408).

In Europe, where it was introduced sixty years ago, the Himalayan Hemlock has not proved very hardy, and usually suffers severely from late spring frosts, although it has produced cones in a few sheltered positions in southern England. (See Fowler, *Gard. Chron.* 1872, 75.) It has not yet shown itself able to withstand the climate of the United States.

[1] Saporta, *Origine Paléontologique des Arbres*, 74.

[2] The Hemlock-trees of eastern North America appear to be peculiarly exempt from attacks by boring insects in the living stems, and nothing practically is known of parasites on the two species which inhabit the northwestern part of the continent. The insects found in the trunks of Hemlocks are usually borers, which prey only upon dead or dying wood, and do not affect living trees. These insects are also found on the allied genera of conifers.

Various species of leaf-eating insects occasionally feed upon the foliage of Tsuga, but few of them are sufficiently abundant to attract attention. The larvæ of a Tineid, *Gelechia abietisella*, Packard, cut off small groups of Hemlock leaves, fasten them together by silken threads, and, living within the protecting case thus formed, devour the parenchyma of adjacent leaves.

A scale-insect, *Aspidiotus Abietis*, Comstock, is sometimes found in abundance on the lower surface of the leaves of *Tsuga Canadensis*.

[3] *Tsuga Canadensis* is attacked by a number of interesting fungi peculiar to this host, besides several others found also on other related genera. Among the former is the rust, *Peridermium Peckii*, Thuemen. This æcidium, or cluster-cup, is found in summer on the under side of the leaves, and resembles *Peridermium columnare*, Albertini & Schweinitz, of Europe, which infests the leaves of *Abies Picea*, and is connected with *Calyptospora Gœppertiana*, Kuehn, on species of Vaccinium. *Peridermium Peckii* appears to be a distinct species, although it is not known with what teleutosporic form it is connected. Two other rusts have been observed on the leaves of *Tsuga Canadensis* in Massachusetts (see Farlow, *Proc. Am. Acad.* xx. 322), one of them appearing to be the same as *Chrysomyxa Abietis*, Rees, which infests *Picea Abies* in Europe, and the other, *Cæorna Abietis-Canadensis*, Farlow, which is related to *Cæorna Abietis-pectinatæ*, Rees. A disease of the leaves of *Tsuga Canadensis* appears to be due to the attacks of *Propolidium Tsugæ*, Saccardo, a small dark brown Discomycete which is developed on the under side of the leaves, and causes them to fall in large numbers.

Tsuga Canadensis is subject also to the attacks of a few other species of Ascomycetes, and of a considerable number of Polyporeaceæ, mostly not confined to this host. *Polyporus Pilotæ*, Schweinitz, infests *Tsuga Canadensis* on the mountains of the middle states.

Three species of fungi have been reported as infesting *Tsuga Mertensiana*, *Anthostemella brachystoma*, Ellis & Everhardt, *Lasiosphæria stuppea*, Ellis & Everhardt, and *Blitrydium signatum*, Saccardo.

[4] *Syn. Conif.* 83 (1847).

CONSPECTUS OF THE NORTH AMERICAN SPECIES.

MICROPEUCE.
- Leaves flat, obtuse or emarginate at the apex, stomatiferous only on the lower surface; cones ovate-oblong or oval.
  - Cones pedunculate.
    - Cone-scales orbicular-oblong, about as wide as long, their bracts broad and truncate. 1. T. CANADENSIS.
    - Cone-scales oblong, much longer than wide, spreading at right angles after maturity, their bracts obtusely cuspidate . . . . 2. T. CAROLINIANA.
  - Cones sessile.
    - Cone-scales oblong, longer than broad, often abruptly contracted near the middle, their bracts slightly cuspidate . . . . 3. T. HETEROPHYLLA.

HESPEROPEUCE.
- Leaves convex or keeled above, bluntly pointed, stomatiferous on both surfaces.
  - Cones oblong-cylindrical.
    - Cone-scales oblong-obovate, longer than broad, their bracts short cuspidate . . 4. T. MERTENSIANA.

TSUGA CANADENSIS.

Hemlock.

Cones ovate-oblong, pedunculate, their scales orbicular-oblong, nearly as wide as long.

Tsuga Canadensis, Carrière, *Traité Conif.* 189 (excl. syn. Bongard) (1855). — Sénéclauze, *Conif.* 19. — Engelmann, *Bot. Gazette*, vi. 224. — Regel, *Russ. Dendr.* ed. 2, pt. i. 39, f. 10. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 206. — Willkomm. *Forst. Fl.* ed. 2, 103. — Watson & Coulter, *Gray's Man.* ed. 6, 492. — Mayr, *Wald. Nordam.* 195, t. 6, f. — Beissner, *Handb. Nadelh.* 398, f. 107-109. — Masters, *Jour. R. Hort. Soc.* xiv. 255. — Hansen, *Jour. R. Hort. Soc.* xiv. 442 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 11, f. 5, B, D-H, M. — Rothrock, *Forest Leaves*, iv. 169, t.; *Rep. Dept. Agric. Penn.* 1895, pt. ii. *Div. Forestry*, 188, 282, t. 31, 38. — Britton & Brown, *Ill. Fl.* i. 56, f. 124.

Pinus Canadensis, Linnæus, *Spec.* ed. 2, 1421 (excl. syn.) (1763). — Moench, *Bäume Weiss.* 72. — Wangenheim, *Nordam. Holz.* 39, t. 15, f. 36. — Schoepf, *Mat. Med. Amer.* 143. — Ehrhart, *Beitr.* iii. 23. — Willdenow, *Berl. Baums.* 219; *Spec.* iv. pt. i. 505; *Enum.* 989. — Aiton, *Hort. Kew.* iii. 370. — Borkhausen, *Handb. Forstbot.* i. 382. — Lambert, *Pinus*, i. 50, t. 32. — Persoon, *Syn.* ii. 579. — Stokes, *Bot. Mat. Med.* iv. 425. — Bigelow, *Fl. Boston.* 235. — Pursh, *Fl. Am. Sept.* ii. 640. — Nuttall, *Gen.* ii. 223. — Hayne, *Dendr. Fl.* 176. — Elliott, *Sk.* ii. 639. — Sprengel, *Syst.* iii. 885. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 32. — Nees von Esenbeck, *Pl. Med.* t. 83. — Hooker, *Fl. Bor.-Am.* ii. 164 (excl. hab. northwest America and var. β). — Torrey, *Fl. N. Y.* ii. 230. — Antoine, *Conif.* 80, t. 32, f. 3. — Endlicher, *Syn. Conif.* 86. — Gihoul, *Arb. Rés.* 46. — Lawson & Son, *List No. 10, Abietineæ*, 9. — Dietrich, *Syn.* v. 392. — Courtin, *Fam. Conif.* 54. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 428 (excl. syn. Bongard). — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 212, t. 23, f. 3. — Herder, *Act. Hort. Petrop.* xii. 119 (*Pl. Radd.*) (excl. hab. Sitka).

Abies Americana, Miller, *Dict.* ed. 8, No. 6 (1768).

Pinus Abies Canadensis, Muenchhausen, *Hausv.* v. 223 (1770).

Pinus Americana, Du Roi, *Obs. Bot.* 41 (1771); *Harbk. Baums.* ii. 107. — Burgsdorf, *Anleit.* pt. ii. 139. — Castiglioni, *Viag. negli Stati Uniti*, ii. 314.

Pinus-Abies Americana, Marshall, *Arbust. Am.* 103 (1785).

Pinus Mariana, Gærtner, *Fruct.* ii. 59, t. 91, f. 1 (not Du Roi) (1791).

Pinus pendula, Salisbury, *Prodr.* 399 (not Aiton) (1796).

Abies Canadensis, Michaux, *Fl. Bor.-Am.* ii. 206 (not Miller) (1803). — Poiret, *Lamarck Dict.* vi. 522. — Desfontaines, *Hist. Arb.* ii. 580. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 474. — Michaux f. *Hist. Arb. Am.* i. 138, t. 13. — *Nouveau Duhamel*, v. 293, t. 83, f. 1. — Richard, *Comm. Bot. Conif.* 77, t. 17, f. 2. — Link, *Handb.* ii. 479. — Audubon, *Birds*, t. 197. — Lawson & Son, *Agric. Man.* 378. — Rafinesque, *New Fl.* i. 39. — Forbes, *Pinetum Woburn.* 129. — Spach, *Hist. Vég.* xi. 424. — Emerson, *Trees Mass.* 77; ed. 2, i. 92, t. — Nuttall, *Sylva*, iii. 133. — Knight, *Syn. Conif.* 37. — Lindley & Gordon, *Jour. Hort Soc. Lond.* v. 209. — Darlington, *Fl. Cestr.* ed. 3, 291. — Gordon, *Pinetum*, 14. — Chapman, *Fl.* 434. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 27. — Henkel & Hochstetter, *Syn. Nadelh.* 153 (excl. syn. *Abies aromatica*). — (Nelson) Senilis, *Pinaceæ*, 30. — Gray, *Man.* ed. 5, 471. — Hoopes, *Evergreens*, 184, f. 23. — K. Koch, *Dendr.* ii. pt. ii. 249. — Nördlinger, *Forstbot.* 457, f. — Veitch, *Man. Conif.* 114, f. 29. — Lauche, *Deutsche Dendr.* ed. 2, 94. — Schübeler, *Virid. Norveg.* i. 429.

Abies pectinata, Poiret, *Lamarck Dict.* vi. 523 (not Gillibert) (1804). — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 36.

Abies taxifolia, Rafinesque, *New Fl.* i. 38 (not Poiret) (1836).

Abies taxifolia, var. patula, Rafinesque, *New Fl.* i. 39 (1836).

Picea Canadensis, Link, *Linnæa*, xv. 524 (1841).

Picea (Tsuga) Canadensis, Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 89 (1874).

A tree, usually sixty or seventy and occasionally one hundred feet in height, with a trunk from two to four feet in diameter, gradually and conspicuously tapering toward the apex. During its early years the comparatively long and slender branches, which are horizontal or pendulous below and ascending above, form a broad based rather obtuse pyramid, and continue to clothe the stem to the ground unless they are overshadowed by other trees, which gradually destroy the lowest branches, until the trunk, often naked for two thirds of its length, bears only a small narrow spire-like crown of short ascending branches. The bark of the trunk, which varies in color from cinnamon-red to gray more or less tinged with purple, is from one half to three quarters of an inch in thickness, and deeply divided into narrow rounded ridges covered with thick closely appressed scales. The branchlets, which are very slender, when they first appear are light yellow-brown and coated with pale pubescence; during their first winter they are rather darker, and in their third season become glabrous and dark gray-brown tinged with purple. The winter-buds are broadest at the middle, rather obtuse, light chestnut-brown, slightly puberulous, and about one sixteenth of an inch in length. The leaves, which are light yellow-green when they first emerge from the bud, are oblong, rounded and rarely emarginate at the apex, entire or often obscurely denticulate above the middle, dark yellow-green and lustrous on the upper surface, which is obscurely grooved, especially toward the base, marked on the lower surface with five or six rows of stomata on each side of the low broad midrib, from one third to two thirds of an inch long and about one sixteenth of an inch wide, and fall during their third season from the persistent bases which at first are dark orange-color, and, gradually growing darker, continue to roughen the branches slightly for three or four years longer. The staminate flowers, which with their stalks are about three eighths of an inch long and have light yellow anthers, appear in May a little earlier than the pistillate flowers, which are an eighth of an inch in length, and pale green, with broad bracts coarsely laciniate on the margins and longer than their scales. The cones are suspended on slender puberulous peduncles often a quarter of an inch long, and are ovate-oblong, acute, from one half to three quarters of an inch in length, pale green, with orbicular-oblong scales almost as wide as they are long, and broad truncate bracts slightly laciniate on the margins; late in the autumn those portions of the scales which have been exposed to the light become dull gray-brown, while the remainder are bright red-brown; opening and gradually losing their seeds during the winter, they mostly remain on the branches until the following spring. The seeds are one sixteenth of an inch in length and usually marked with two or three large oil vesicles, and are nearly half as long as their wings, which are broad at the base and gradually taper to the rounded apex.

Tsuga Canadensis is distributed from Nova Scotia and New Brunswick to the northern end of Lake Temiscamang on the Ottawa River,[1] and westward through Ontario[2] to eastern Minnesota;[3] southward it ranges through the northern states to Newcastle County in Delaware, southern Michigan and central Wisconsin, and along the Appalachian Mountains to northwestern Alabama.[4] Common in the maritime provinces of Canada, and most abundant in New England, northern New York, and western Pennsylvania, where it is frequently an important element of the forest, the Hemlock of northeastern America attains its largest size near streams on the slopes of the high mountains of North Carolina and Tennessee. Often an inhabitant of rocky ridges, which it sometimes covers when they face the north with dark dense groves where other trees are rarely found, it loves also the steep rocky banks of narrow river gorges, and is scattered through upland forests of White Pine and deciduous-leaved trees and less commonly on the borders of swamps in deep imperfectly drained soil.

The wood of *Tsuga Canadensis* is light, soft, not strong, brittle, coarse, crooked-grained, difficult to work, liable to wind-shake and splinter, and not durable when exposed to the air. It is light brown tinged with red or often nearly white, with thin somewhat darker sapwood, and contains broad conspicuous bands of small summer cells and numerous thin medullary rays. The specific gravity of the absolutely dry wood is 0.4239, a cubic foot weighing 26.42 pounds. It is now largely manufactured into coarse lumber employed for the outside finish of buildings; it is also used for railway-ties, and occasionally for water pipes.[1] Two varieties, red and white hemlock, which, however, appear to be produced under precisely similar conditions, are recognized by lumbermen.

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[1] Provancher, *Fl. Canadienne*, ii. 556. — Brunet, *Cat. Vég. Lig. Can.* 58. — Macoun, *Cat. Can. Pl.* 471.

[2] Agassiz, *Lake Superior, its Physical Character, Vegetation, and Animals*, 165.

[3] *Tsuga Canadensis* was found in April, 1890, by Mr. H. B. Ayres, to the westward of Lake Superior, in Carlton County, Minnesota. (See *Garden and Forest*, iii. 496, 544.)

In the journal of the expedition under General Lewis Cass, which traversed what is now Carlton County in 1820, the Hemlock is spoken of as being abundant in this part of Minnesota, from which it now appears to have almost completely disappeared. (See Schoolcraft, *Narrative Journal of Travels from Detroit Northwest through the Great Chain of American Lakes*, 206, 207, 210. See, also, E. G. Hill, *Garden and Forest*, iii. 553. — Ayres, *Garden and Forest*, vi. 418.) Nicollet, in 1841, speaks of the occasional occurrence of the Hemlock on the Mississippi River, above the Crow Wing, which is much farther west than it is now known (*Rep. Hydrographic Basin Upper Mississippi River*, 64 [*Senate Doc.* 1843]); and Upham refers doubtfully to the existence of the Hemlock at several places in eastern Minnesota (*Rep. Geolog. and Nat. Hist. Surv. Minn.* 1883, pt. vi. 132 [*Cat. Fl. Minn.*]).

[4] In July, 1880, *Tsuga Canadensis* was found by Dr. Charles Mohr growing in deep rocky valleys and gorges at the head-waters of the western fork of the Sipsey River in the northern part of Winston County, Alabama.

The astringent inner bark affords the largest part of the material used in the northeastern states and Canada in tanning leather,[2] and from it is prepared a fluid extract sometimes employed medicinally as an astringent.[3] Canada pitch, an opaque resin obtained from the wood, was formerly used in medicine,[4] and from the young branches oil of hemlock is distilled.[5]

This Hemlock was first described by Plukenet in 1691[6] from a tree cultivated in his garden in London by Bishop Compton,[7] to whom it had been sent from Virginia by John Banister.[8] Its value had been recognized, however, much earlier by the settlers of Canada and New England, and Pierre Boucher[9] and Josselyn[10] extolled its virtues soon after the middle of the seventeenth century.

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[1] See *Am. Jour. Pharm.* xxxiv. 377.

[2] The bark of *Tsuga Canadensis*, which varies considerably in the amount of tannin it contains, is used in enormous quantities in the manufacture of heavy leather, and also in the production of the finer grades of leather, when it is mixed with Oak bark to modify the red color of leather tanned entirely with Hemlock bark. An extract of the bark is used by tanners instead of the bark itself, to strengthen their bark liquors. It is also employed by dyers to modify the shades of logwood coloring, especially when copper sulphide is used as a mordant. (See Bastin & Trimble, *Am. Jour. Pharm.* lxix. 94. See, also, for the tannin of Hemlock bark, Procter, *Text-book of Tanning*, 31. — Mulligan & Dowling, *Chemical Gazette*, xvii. 430. — Mafat, *Bull. Soc. Industrielle de Mulhouse*, lxii. 130. — Olivier, *Recherches pour servir à l'Histoire Naturelle, Chimique et Industrielle du Hemlock.*)

[3] See Johnson, *Man. Med. Bot. N. Am.* 259. — Millspaugh, *Am. Med. Pl. in Homœopathic Remedies*, ii. 164, t. 164. — Parke, Davis & Co., *Economic Mat. Med.* ed. 2, 93.

[4] Canada pitch, formerly often known as Hemlock resin, is an opaque brittle resin which is obtained from *Tsuga Canadensis* by boiling the wood and bark from around knots with water, and skimming off the resin which rises to the surface. It is also said to be obtained from incisions made in the trunks of living trees in the same manner that turpentine is obtained from Pine-trees. Canada pitch was formerly used as a substitute for the similar Burgundy pitch in the manufacture of medical plasters, and was collected in considerable quantities. It has now, however, disappeared from the United States Pharmacopœia, and is replaced by asphalt or rubber in the manufacture of medical plasters. (See Ellis, *Jour. Phil. College of Pharmacy*, ii. 18 [On Hemlock Resin]. — Stearns, *Am. Jour. Pharm.* xxxi. 28 [*Medical Plants of Michigan*]. — Bentley & Trimen, *Med. Pl.* iv. 264, t. 264. — *U. S. Dispens.* ed 17, 1174. — Bastin & Trimble, *l. c.* 91.)

[5] Oil of Hemlock, which is contained in the leaves of *Tsuga Canadensis*, and appears to be identical in chemical composition with the volatile oil of Black Spruce leaves, is obtained in winter by distilling in water in small portable copper stills and worms set up in the woods the branches of *Tsuga Canadensis* cut up into small pieces. Eight pounds of branches yield on an average an ounce of oil, or about three pints to one running of a still, which occupies from thirteen to twenty-four hours. (See Stearns, *l. c.* — Bertram & Walbaum, *Archiv. de Pharm.* ccxxxi. 294. — Hunkel, *Pharmaceutical Review*, xiv. 34. — Bastin & Trimble, *l. c.* 90.) Oil of Hemlock is used in considerable quantities as a flavoring and for disinfecting purposes, and occasionally in medicine to produce abortion.

[6] *Abies minor pectinatis foliis, Virginiana, conis parvis, subrotundis*, Plukenet, *Phyt.* t. 121, f.; (excl. syn. Hernandez) *Alm. Bot.* 2. — Ray, *Hist. Pl.* iii. *Dendr.* 8. — Miller, *Dict.* No. 3. — Duhamel, *Traité des Arbres*, i. 3.

Abies foliis solitariis confertis obtusis membranaceis, Clayton, *Fl. Virgin.* 191.

[7] See i. 6.

[8] See i. 6.

[9] "Il y a encore une autre espece qu l'on appelle Prusse; ce sont ordinairement de gros arbres qui ont trente ou quarante pieds de haut sans branches : ils ont une grosse écorce et rouge: ce bois ne pourrit pas si facilement que les autres; c'est pourquoy on s'en sert ordinairement pour bastir. Ce qu'il y a de mal dans ce bois, c'est qu'il s'en trouve quantité de rouillé, ce que le fait rebuter. De celuy-là il en vient par tout, en bonne et mauvaise terre; il ne produit point de gomme." (*Histoire Veritable et Naturelle des Mœurs et Productions du Pays de la Nouvelle-France vulgairement dite le Canada*, ed. 3, 51.)

[10] "Then she Playstered it with the Bark of *Board Pine*, or *Hemlock Tree*, boyled soft and stampt betwixt two stones, till it was as thin as brown Paper, and of the same Colour, she annointed the Playster with *Soyles Oyl*, and the Sore likewise, then she laid it on warm, and sometimes she made use of the bark of the *Larch Tree.*" (Josselyn, *New England's Rarities*, 62.)

"*Hemlock Tree*, a kind of *Spruce*, the bark of this Tree serves to dye Tawny; the Fishers Tan their Sails and Nets with it.

"The Indians break and heal their Swellings and Sores with it, boyling the inner Bark of young *Hemlock* very well, then knocking of it betwixt two stones to a Playster, and annointing or soaking it in Soyls Oyl, they apply it to the Sore : It will break a Sore Swelling speedily." (Josselyn, *New England's Rarities*, 64.)

"The Hemlock-Tree is a kind of spruce or pine; the bark boiled and stampt till it be very soft is excellent for to heal wounds, and so is the Turpentine thereof, and the Turpentine that issueth from the Cones of the Larch-tree (which comes nearest of any to the right Turpentine) is singularly good to heal wounds and to draw out the malice (or Thorn as *Helmont* phrases it) of any Ach, rubbing the place therewith, and strowing upon it the powder of *Sage*-leaves." (Josselyn, *An Account of Two Voyages to New England*, p. 67.)

For a century and a half a favorite ornament of the parks and gardens of the United States and Europe,[1] *Tsuga Canadensis* has shown in cultivation a tendency to seminal variation, and a number of the abnormal forms which have been produced in nurseries or have been found growing in the forest are preserved by the cultivators of curious plants.[2] In beauty none of them, however, equals the normal form, which in stately grace has no rival among the inhabitants of the gardens of the northern United States, when, with its long lower branches sweeping the lawn, it rises into a great pyramid dark and sombre in winter and light in early summer, with the tender yellow tones of its drooping branchlets and vernal foliage.

Serious inroads have already been made into the Hemlock forests of the northern and middle states, and the best trees have everywhere been destroyed to supply the tanner, who finds in the astringent bark of this tree one of the most valuable materials for his industry.[3]

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[1] Loudon, *Arb. Brit.* iv. 2299, t. (as *Abies Canadensis*).

[2] The abnormal cultivated forms of *Tsuga Canadensis* are distinguished in some cases by a dwarf and compact habit, in others by fastigiate branches and by unusually broad or narrow leaves, or by foliage slightly marked with white. About eighteen of these forms are cultivated, but none of them has any particular beauty or value. (See Beissner, *Handb. Nadelh.* 409. — Sudworth, *Bull.* No. 14, *U. S. Dept. Agric. Div. Forestry*, 49.) More distinct is a variety with short pendulous branchlets forming a dense cushion from two to three feet in height and twenty feet across, which was found about thirty years ago on the Fishkill Mountains in New York, and which, introduced into gardens by Mr. Henry Winthrop Sargent, is occasionally to be seen in American collections, where it is usually known as Sargent's Hemlock.

[3] *Tsuga Canadensis*, which is commonly distributed and was once abundant over a territory fully half a million square miles in area, is one of the most valuable trees of the eastern forest. It is estimated that in the year 1887 1,200,000 tons of bark of this tree were harvested; and although a large part of the timber of the trees cut and stripped of their bark is allowed to rot on the ground, it is believed that the average annual value of the material of all kinds obtained from this Hemlock is not less than $30,000,000.

The seeds of the Hemlock, although they are produced in great abundance, do not germinate freely in open situations or on ground which has been recently burned over, and the young seedlings grow slowly, plants under favorable conditions being not more than three or four inches high at the end of their fourth season. The young plants are easily destroyed by fire and browsing animals, and the prospect for the natural restoration of the Hemlock forests is not promising. (See Prentiss, *Garden and Forest*, iii. 157.) Even under the most favorable conditions the Hemlock increases slowly both in height and in trunk diameter. The specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, obtained in northern New York, is thirteen and one half inches in diameter inside the bark and one hundred and sixty-four years old, the sapwood being two inches in thickness with twenty-nine layers of annual growth.

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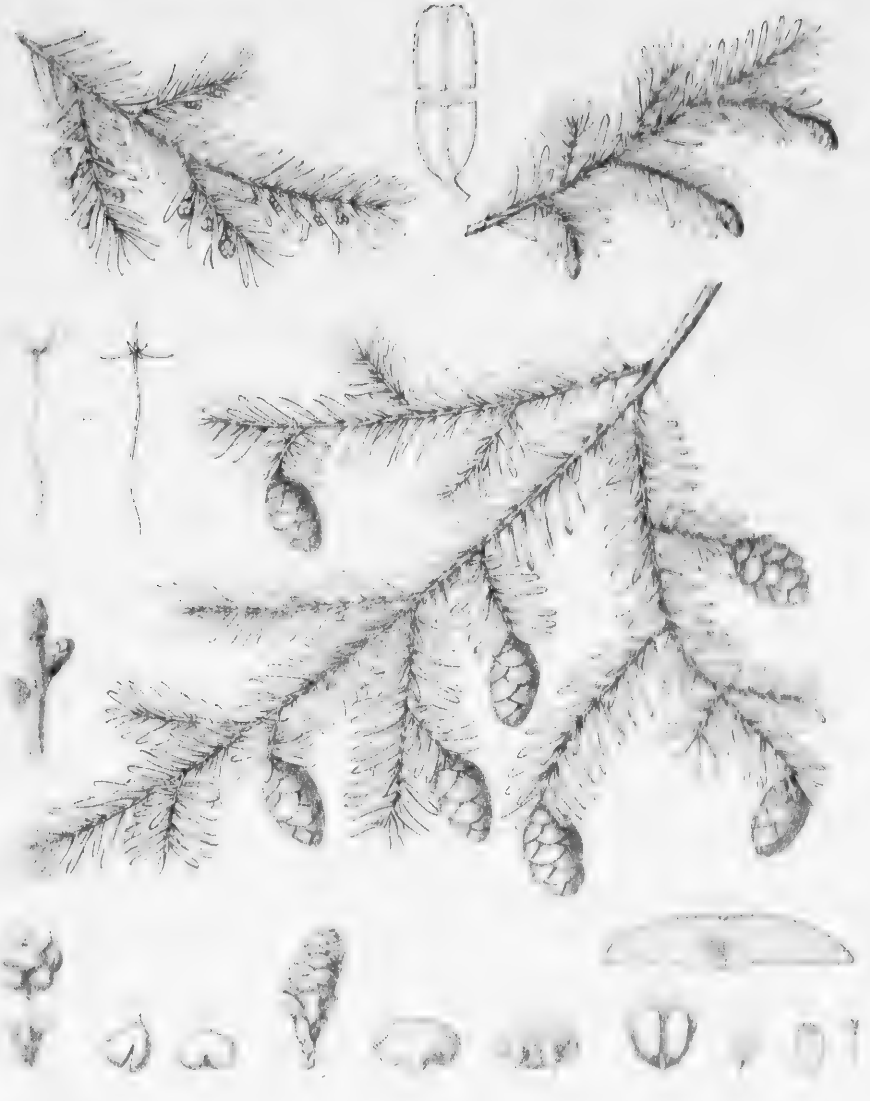
EXPLANATION OF THE PLATE.

PLATE DCIII. TSUGA CANADENSIS.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, side view, enlarged.
4. An anther, front view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, lower side, with its bract, enlarged.
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A fruiting branch, natural size.
10. A cone-scale, upper side, with its seeds, natural size.
11. A seed, natural size.
12. Vertical section of a seed, enlarged.
13. An embryo, enlarged.
14. Cross section of a leaf magnified fifteen diameters.
15. A leaf divided transversely, enlarged.
16. Winter branch-buds, enlarged.
17. Seedling plants, natural size.



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[illegible] THE PLATE

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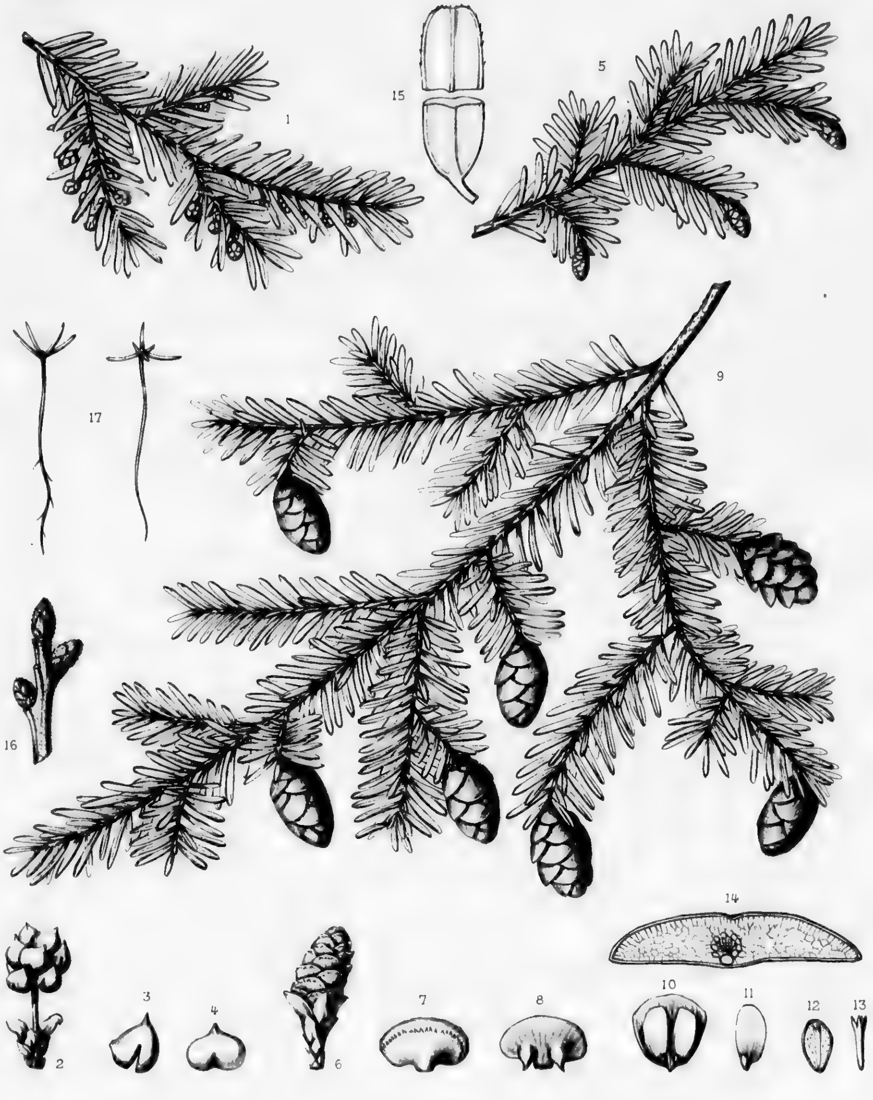
1. [illegible]
2. A staminate flower, enlarged.
3. An anther, side view, enlarged.
4. An anther, front view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, [illegible]
8. A scale of a pistillate flower, upper side, with its ovules, enlarged.
9. A fruiting branch, natural size.
10. A cone-scale, upper side, with its seeds, natural size.
11. A seed, natural size.
12. Vertical section of a seed, enlarged.
13. An embryo, enlarged.
14. Cross section of a leaf, magnified [illegible] diameters.
15. A leaf divided transversely, enlarged.
16. A winter branch-bud, enlarged.
17. Seedling plants, natural size.



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TSUGA CANADENSIS, Carr.

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TSUGA CAROLINIANA.

Hemlock.

Cones oblong, pedunculate, their scales longer than broad, spreading at right angles at maturity.

Tsuga Caroliniana, Engelmann, *Bot. Gazette*, vi. 223 (1881). — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 207; *Gard. Chron.* n. ser. xxvi. 780, f. 153 (excl. f. 5). — Mayr, *Wald. Nordam.* 196, t. 6, f. — Beissner, *Handb. Nadelh.* 406, f. 111. — Masters, *Jour. R. Hort. Soc.* xiv. 255. — Hansen, *Jour. R. Hort. Soc.* xiv. 445 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 11, f. 5, O. — Britton & Brown, *Ill. Fl.* i. 56, f. 125. — Chapman, *Fl.* ed. 3, 458.

Abies Caroliniana, Chapman, *Fl.* ed. 2, Suppl. 650 (1887).

A tree, usually forty or fifty and occasionally seventy feet in height, with a trunk rarely exceeding two feet in diameter,[1] with comparatively short stout and often pendulous branches which form a handsome compact pyramidal head. The bark of the trunk is from three quarters of an inch to an inch and a quarter in thickness, and is reddish brown on the surface and deeply divided into broad flat connected ridges covered with thin closely appressed plate-like scales. The slender branchlets, when they first appear, are light orange-brown, coated with short dark pubescence which nearly entirely disappears during their first season or continues to cover them until they are three years old, when the bark is dull brown more or less tinged with orange and then begins to separate into the small thin loose scales of the older branches. The winter-buds are obtuse, nearly an eighth of an inch in length, dark chestnut-brown, and covered with pubescence which is thickest near the margins of the scales. The leaves are entire, retuse or often emarginate at the apex, very dark green and lustrous on the upper surface, which is conspicuously grooved, and marked on the lower surface with a band of seven or eight rows of stomata on each side of the midrib; they are from one third to three quarters of an inch long, the difference in length between those on the same branchlet being usually less than in the other flat-leaved Hemlocks, and about one twelfth of an inch wide, with orange-red bases from which they fall during their fifth year. The staminate flowers are tinged with purple and the pistillate flowers, which are about an eighth of an inch in length, are purple, with broadly ovate bracts scarious and erose on the margins. The cones are oblong, from an inch to an inch and a half in length, and are suspended on short stout peduncles; their scales are oblong, gradually narrowed and rounded at the apex, rather abruptly contracted at the base into distinct stipes, thin, concave, striately grooved and puberulous on the outer surface, twice as long as they are broad, and pale brown at maturity, when they spread nearly at right angles to the axis of the cone; their bracts are rather longer than they are wide, wedge-shaped below and nearly truncate or slightly cuspidate at the broad apex. The seeds are one sixth of an inch in length, with from fifteen to twenty small oil vesicles on the lower side, and are one quarter as long as the pale lustrous wings, which, broad or narrow at the base, are narrowed to the rounded apex.

An inhabitant of the rocky banks of streams, usually at elevations of between two thousand five hundred and three thousand feet above the level of the sea, but sometimes ascending a thousand feet higher, the Carolina Hemlock is nowhere very common, although it is widely scattered along the Blue

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[1] The trunk of a tree of this Hemlock growing on the banks of Overflow Creek, near Highlands, North Carolina, measured several years ago by Mr. F. H. Boynton, had a circumference three feet above the ground of eight feet nine and three quarters inches. I have not heard of a larger specimen.

Ridge from southwestern Virginia[1] to northeastern Georgia;[2] usually growing singly or in small scattered groves of a few trees, it is associated in the forest with the northern Hemlock, the White Pine, Gum-trees, Maples, and Hickories, and is probably most abundant in South Carolina on the streams which form the Savannah River.[3]

The wood of *Tsuga Caroliniana* is light, soft, not strong, brittle, and coarse-grained; it is pale brown tinged with red, with thin nearly white sapwood, and contains narrow inconspicuous bands of small summer cells and numerous thin medullary rays. The specific gravity of the absolutely dry wood is 0.4275, a cubic foot weighing 26.64 pounds.[4]

Unnoticed by the botanists who frequently explored the southern Appalachian Mountains during the last half of the eighteenth and the first half of the nineteenth centuries, *Tsuga Caroliniana* was first distinguished in 1850[5] by Professor L. R. Gibbes.[6] It was introduced into northern gardens in 1881 through the Arnold Arboretum and has proved perfectly suited to the climate of New England. Of denser habit than the northern Hemlock, and with longer darker green more lustrous and more persistent leaves, it promises to excel even that tree as an ornament of parks and gardens.

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[1] In June, 1892, *Tsuga Caroliniana* was found by N. L. and Elizabeth G. Britton and Anna Murray Vail in the north fork of the Houston River valley, Smythe County, Virginia, at an altitude of two thousand two hundred feet above the sea; and the following year it was detected by Mr. John K. Small near Broad Ford and along Comer Creek, Smythe County, and on Farmer Mountain on New River, Carroll County, in the same state.

[2] In August, 1895, *Tsuga Caroliniana* was found by Mr. John K. Small near Tallula Falls, Habersham County, Georgia, at an elevation of only sixteen hundred feet above the sea-level.

[3] See Sargent, *Garden and Forest*, ii. 267, f.

[4] Probably *Tsuga Caroliniana*, like the northern Hemlock, usually grows slowly. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, procured from western South Carolina, is fourteen and one half inches in diameter inside the bark, and one hundred and seventy years old. During its last twenty years, however, this trunk increased four and a half inches in diameter, the sapwood being seven eighths of an inch in thickness, with only nine layers of annual growth.

[5] In 1842 a specimen of this Hemlock, without fruit, was collected by Professor Asa Gray on Bluff Mountain, North Carolina, but was not distinguished by him from the northern species. In 1850 Professor Gibbes found it in both North and South Carolina; and in 1856 he sent specimens to Professor Gray with the suggestion that the tree should be called *Pinus laxa*, a name which was never published. At a meeting of the Elliott Society, held in Charleston, South Carolina, in July, 1858, he reported his discovery. (See *Proc. Elliott Soc.* i. 286, where occurs the first printed mention of this tree.)

[6] Lewis Reeve Gibbes (August 14, 1810–November 21, 1894), the oldest child of Lewis Ladson Gibbes and Maria Henrietta Drayton, was born in Charleston, South Carolina. The foundation of his classical education was laid at the Grammar School of the University of Pennsylvania in Philadelphia in the years 1821 and 1822, but he was fitted for college at the Pendleton Academy, South Carolina, between 1823 and 1827. In this last year he was admitted to the junior class of the South Carolina College at Columbia and was graduated in December, 1829, with the highest honors. At the end of 1831, having previously performed the duties of principal of Pendleton Academy, giving instruction in the classics and in mathematics, he began the study of medicine at Charleston, but before the close of another year was appointed tutor in mathematics in the College of South Carolina. Losing this position by reason of a revolution in the college in December, 1834, when all the officers were requested to resign, on the following day he was made professor of mathematics in the new organization, but resigned during the next year, and in 1836 visited Paris for the purpose of completing his medical education and studying physics and botany. Returning to Charleston in 1838, with the intention of practicing medicine, he was appointed professor of mathematics in the College of Charleston, where he retained his chair until July, 1892, teaching physics, chemistry, and mineralogy. Botany and various departments of zoölogy were also among his special studies. Between 1848 and 1853 Professor Gibbes was engaged in making observations for the Coast Survey to determine the differences of longitude between Charleston and various points on the Atlantic coast. He was the author of numerous papers on astronomy, physics, and zoölogy, printed in various scientific periodicals and in the Proceedings of learned societies. His most important botanical papers are *A Catalogue of the Phænogamous Plants of Columbia, South Carolina, and its Vicinity*, published in October, 1835, which contains the names of about nine hundred species, accompanied in some cases by critical notes, and the *Botany of Edings Bay*, published in 1859 in the first volume of the *Proceedings of the Elliott Society*.

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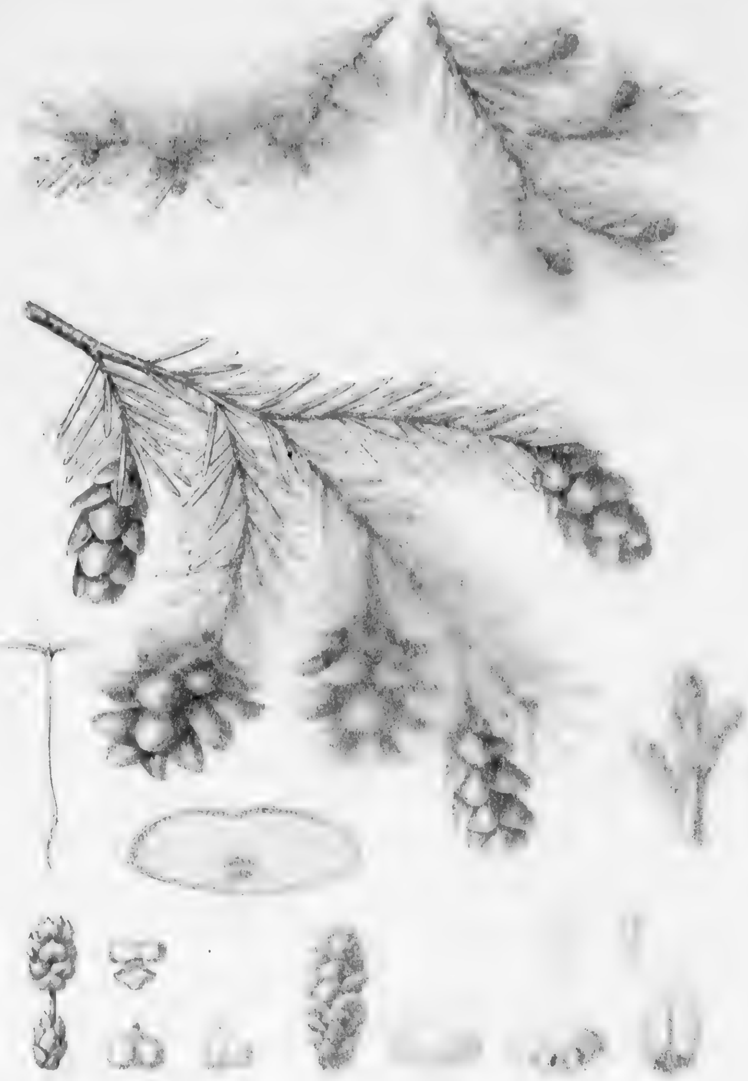
EXPLANATION OF THE PLATE.

PLATE DCIV. TSUGA CAROLINIANA.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, lower side, enlarged.
4. An anther, front view, enlarged.
5. An anther, side view, enlarged.
6. A branch with pistillate flowers, natural size.
7. A pistillate flower, enlarged.
8. A scale of a pistillate flower, lower side, with its bract, enlarged.
9. A scale of a pistillate flower, upper side, with its ovules, enlarged.
10. A fruiting branch, natural size.
11. A cone-scale, upper side, with its seeds, natural size.
12. Vertical section of a seed, enlarged.
13. An embryo, enlarged.
14. Cross section of a leaf, magnified fifteen diameters.
15. Winter branch-buds, enlarged.
16. A seedling plant, natural size.



EXPLANATION OF THE PLATE.

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[illegible] enlarged.

[illegible] side, enlarged.

[illegible] front view, enlarged.

5. An anther, side view, enlarged.

6. A branch with pistillate flowers, natural size.

7. A pistillate flower, enlarged.

8. A scale of a pistillate flower, lower side, [illegible]

9. A scale of a pistillate flower, upper side, with its ovules, enlarged.

10. A fruiting branch, natural size.

11. A cone-scale, upper side, with its seeds, natural size.

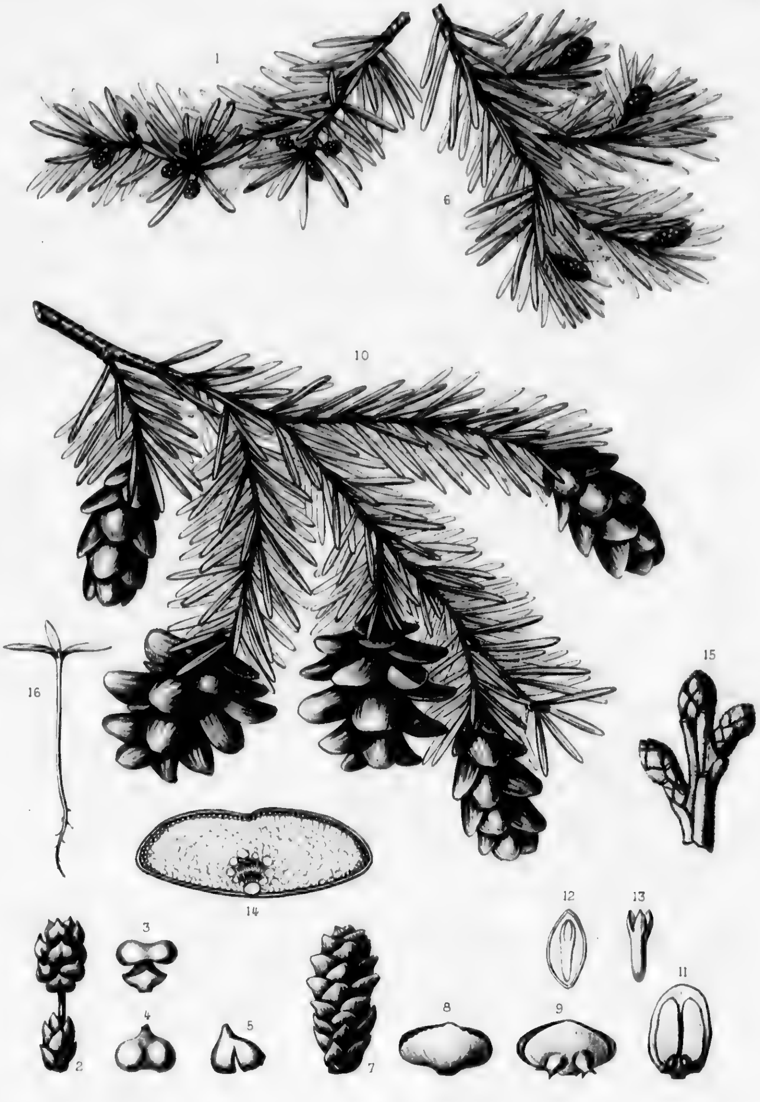
12. Vertical section of a seed, enlarged.

13. An embryo, enlarged.

14. Cross section of a leaf, magnified [illegible]

15. Winter branch-buds, enlarged.

16. A seedling plant, natural size.



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TSUGA HETEROPHYLLA.

Hemlock.

Cones oblong-oval, sessile, their scales longer than broad, often abruptly contracted near the middle.

Tsuga heterophylla.

Pinus Canadensis, Bongard, *Vég. Sitcha*, 45 (not Linnæus) (August, 1832); *Mém. Phys. Math. Nat.* pt. ii. *Acad. Sci. St. Pétersbourg*, ii. 163 (*Vég. Sitcha*). — Hooker, *Fl. Bor.-Am.* ii. 164 (in part). — Ledebour, *Fl. Ross.* iii. 668 (excl. syn.). — Herder, *Act. Hort. Petrop.* xii. 119 (*Pl. Radd.*) (in part).

Abies heterophylla, Rafinesque, *Atlant. Jour.* i. 119 (Autumn, 1832); *New Fl.* i. 37. — Endlicher, *Syn. Conif.* 124. — Carrière, *Traité Conif.* 265.

Abies microphylla, Rafinesque, *Atlant. Jour.* i. 119 (Autumn, 1832); *New Fl.* i. 38. — Endlicher, *Syn. Conif.* 126. — Carrière, *Traité Conif.* 267.

Abies Mertensiana, Gordon, *Pinetum*, 18 (excl. syn. Bongard) (not Lindley & Gordon) (1858). — A. Murray, *Proc. R. Hort. Soc.* iii. 144, f. 8, 10, 12, 14, 16. — Lyall, *Jour. Linn. Soc.* vii. 133, 143. — Henkel & Hochstetter, *Syn. Nadelh.* 152. — Cooper, *Am. Nat.* iii. 412. — Hoopes, *Evergreens*, 192. — K. Koch, *Dendr.* ii. pt. ii. 250. — Hall, *Bot. Gazette*, ii. 94. — Lauche, *Deutsche Dendr.* ed. 2, 94.

Abies Canadensis? Cooper, *Smithsonian Rep.* 1858, 262 (not Miller nor Desfontaines) (1859); *Pacific R. R. Rep.* xii. pt. ii. 69.

Abies Bridgesii, Kellogg, *Proc. Cal. Acad.* ii. 8 (1863).

Abies Albertiana, A. Murray, *Proc. R. Hort. Soc.* iii. 149. f. 6, 7, 9, 11, 13, 15 (1863). — Lawson, *Pinetum Brit.* ii. 111, t., f. 1-18. — (Nelson) Senilis, *Pinaceæ*, 31.

Tsuga Mertensiana, Carrière, *Traité Conif.* ed. 2, 250 (1867). — Engelmann, *Brewer & Watson Bot. Cal.* ii. 120; *Bot. Gazette*, vi. 224. — Kellogg, *Trees of California*, 41. — Regel, *Russ. Dendr.* ed. 2, pt. i. 39. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 207. — Masters, *Gard. Chron.* n. ser. xxiii. 179, f. 35; ser. 3, xii. 11, f. 2; *Jour. R. Hort. Soc.* xiv. 255. — Mayr, *Wald. Nordam.* 338, t. 6, f. — Lemmon, *Rep. California State Board Forestry*, iii. 125, t. 7, 8 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 53; *Bull. Sierra Club*, ii. 159 (*Conifers of the Pacific Slope*). — Beissner, *Handb. Nadelh.* 403, f. 110. — Hansen, *Jour. R. Hort. Soc.* xiv. 447 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 11, f. 5, J.

Tsuga Albertiana, Sénéclauze, *Conif.* 18 (1867).

Pinus Mertensiana, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 428 (not Bongard) (1868). — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 211, 212, t. 23, f. 4. — Herder, *Act. Hort. Petrop.* xii. 119 (*Pl. Radd.*).

Pinus Pattoniana, W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 211, 212, t. 23, f. 2 (not Parlatore) (1875).

Abies Pattonii, W. R. M'Nab, *Jour. Linn. Soc.* xix. 208 (1882).

A tree, frequently two hundred feet in height, with a tall trunk from six to ten feet in diameter, and short slender usually pendulous branches which form a narrow pyramidal head. The bark on young trunks is thin, dark orange-brown, and separated by shallow fissures into narrow flat plates which break into delicate scales; and on fully grown trees it is from an inch to an inch and a half in thickness and deeply divided into broad flat connected ridges covered with closely appressed scales which are brown more or less tinged with cinnamon-red. The branchlets, which are very slender and pale yellow-brown for two or three years, and ultimately become dark reddish brown, with thin scaly bark, are coated, when they first appear, with long pale hairs, and are pubescent or puberulous for five or six years. The winter-buds are ovate, about one sixteenth of an inch in length, and bright chestnut-brown. The leaves are rounded at the apex, entire or minutely spinuloso-denticulate above the middle, conspicuously grooved, dark green and very lustrous on the upper surface, marked below with broad white bands of from seven to nine rows of stomata, abruptly contracted at the base into slender petioles, from one quarter to three quarters of an inch long and from one sixteenth to one twelfth of an inch wide. The staminate flowers are yellow, about an eighth of an inch in length and rather shorter than their slender pendulous stipes. The pistillate flowers are purple and puberulous, with broadly ovate bracts which are scarious and nearly entire on the margins and rather longer than the acute scales. The cones are oblong-oval, acute, sessile, from three quarters of an inch to an inch in length, and slightly puberulous on the outer surface of the scales, which are longer than they are broad, often abruptly narrowed near the middle, thin, striate on the outer surface, green more or less tinged with purple toward the margins until fully grown, and light reddish brown at maturity; their bracts are dark purple, puberulous, and rounded and abruptly contracted at the apex into short points. The seeds are about an eighth of an inch in length, with only occasional oil vesicles, and are from one half to one third as long as their narrow wings.

Tsuga heterophylla is common in southeastern Alaska,[1] where it forms with the Tideland Spruce the largest part of the great coast forest which extends from the sea-level up to elevations of about two thousand feet, sometimes one species and sometimes the other predominating. In British Columbia it is very abundant on the coast; it extends up the valley of the Fraser and other rivers in the southern part of the territory to the limit of the region of abundant rains, and, reappearing on the Selkirk and Gold Ranges, spreads eastward along the Kicking Horse to the western slopes of the continental divide.[2] It is one of the commonest and largest trees in the coniferous forest which extends from the coast of Washington and Oregon to the western slopes of the Cascade Mountains,[3] and in the Redwood forests of the California coast as far south as Cape Mendocino, finding its southern home in Marin County. In the interior *Tsuga heterophylla* ranges eastward along the mountains of northern Washington to the western slopes of the Rocky Mountains of northern Montana and to the Cœur d'Alene and Bitter Root Mountains of Idaho.[4] Although it is most abundant and of largest size in the moist valleys and on low slopes near the coast, *Tsuga heterophylla* in the interior, where it sometimes ascends to elevations of six thousand feet above the sea, attains a large size when it is abundantly supplied with moisture, and in northern Montana and Idaho and in southern British Columbia often forms a considerable part of the forests, in which it is associated with the White Fir, the Douglas Spruce, the Mountain Pine, the western Larch, and the Engelmann Spruce.[5]

The wood of *Tsuga heterophylla* is light, hard, and tough; it is pale brown tinged with yellow, with thin nearly white sapwood, and contains thin inconspicuous bands of small summer cells and numerous prominent medullary rays. The specific gravity of the absolutely dry wood is 0.5182, a cubic foot weighing 32.29 pounds. Stronger, more durable, and more easily worked than the wood of the other American Hemlocks, it is now largely manufactured into lumber used principally in the construction of buildings. The bark, which is used in large quantities, furnishes the most valuable tanning material produced in the forests of British Columbia, Washington, and Oregon.[1] From the inner bark the Indians of Alaska obtain one of their principal articles of vegetable food.[2]

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[1] Rothrock, *Smithsonian Rep.* 1864, 433 (*Fl. Alaska*). — Meehan, *Proc. Phil. Acad.* 1884, 93. — F. Kurtz, *Bot. Jahrb.* xix. 425 (*Fl. Chilcatgebietes*). — Gorman, *Pittonia*, iii. 68.

The most western point on the Alaska coast where *Tsuga heterophylla* has been observed is on Hinchinbrook Island at the mouth of Prince William Sound in latitude 60° 13′ north, where it was seen by Dr. J. M. Macoun on June 18, 1892. The Spruce forest, however, extends along the shores of Prince William Sound and covers the eastern extremity of Kadiak Island, where the Pacific forests end, and it is not impossible that the Hemlock may still be found farther to the westward, although on the shores of Yakutat Bay, in latitude 60°, it is said to be less abundant and of smaller size than the Spruce. (See Funston, *Contrib. U. S. Nat. Herb.* iii. 328.) It is common but of small size on the lower seaward slopes of the mountains at the head of the Lynn Canal, a hundred miles north of Sitka and also near the sixtieth degree of latitude. On Baranoff Island it grows to a very large size a few feet above the sea-level; and between Cross Sound and Cape Mendocino, a distance of nearly fifteen hundred miles, it is one of the commonest trees in the humid coast region, in Alaska usually ascending above the Spruce, its constant companion at the north, and southward mingling also with the Douglas Spruce, the White Fir, and the Arbor Vitæ, and in California with the Redwood.

[2] G. M. Dawson, *Can. Nat.* n. ser. ix. 324. — Macoun, *Cat. Can. Pl.* 471.

On the western slope of the Selkirk Mountains of British Columbia the Hemlock is abundant and of large size up to elevations of about five thousand feet above the sea-level, often forming a large part of the forest growth, being mingled with the Engelmann Spruce, the Patton Spruce, and the Mountain Fir.

[3] The most southern point on the western slope of the Cascade Mountains at which *Tsuga heterophylla* has been noticed is at the northern base of Huckleberry Mountain in the valley of Union Creek and about twelve miles southwest of Crater Lake (Coville *in litt.*).

[4] Leiberg, *Contrib. U. S. Nat. Herb.* v. 54.

[5] Without regular and abundant supplies of water *Tsuga heterophylla* remains small and stunted, and in the search for moisture trees which have sprung up on dry slopes will send their roots for great distances near the surface of the ground to springs at lower levels.

In the coast region, where this tree delights in the humidity which every breeze brings in from the ocean, the forest floor is so deeply covered with mosses and with many strong growing shrubs that the delicate seeds of the Hemlock often find their only opportunity to germinate on the trunks of fallen trees, which, in consequence, are frequently covered with miniature Hemlock forests. Some of these seedlings, more vigorous than their companions, survive the hardships of overcrowding, and, sending their roots into the ground around the trunks which had been their seed-beds, grow into great trees. Like those of some tropical Fig-trees, the seeds of the Hemlock sometimes germinate in the humid coast forests high in the air on the broken stems of trees, and, sending stout and vigorous roots down to the ground, continue to live long after their hosts have disappeared.

The earliest mention of the western Hemlock was published in 1798 in the account of Vancouver's voyage of discovery.[3] In May, 1792, he had seen it near the shores of Puget Sound; and in July of the following year Mackenzie,[4] in the first journey made by a white man across the continent of North America, noticed it near the Pacific coast in about latitude 52° north.[5] The first description of this tree, however, was not published until 1814 in the journal of the transcontinental expedition under the command of Lewis and Clark, who passed the winter of 1805 near the mouth of the Columbia River, where the Hemlock is still one of the commonest trees of the forest.[6]

The noblest of Hemlock-trees in girth and height of stem, *Tsuga heterophylla*,[7] surpasses all its associates in the forests of northwestern America in the graceful sweep of its long and drooping branches and in its delicate lustrous foliage. Introduced into cultivation in 1851 by John Jeffrey,[1] *Tsuga heterophylla* flourishes in the gardens of temperate Europe, where it has grown rapidly, and where, with long lower branches resting on the ground, slender drooping branchlets, and pendent leading shoots, it well displays the beauties of its vigorous youth.[2]

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[1] Bastin & Trimble, *Jour. Pharm.* lxi. 354.

[2] See xi. 93.

[3] "The parts of the vegetable kingdom applicable to useful purposes appeared to grow very luxuriantly, and consisted of the Canadian and Norwegian hemlock, silver pines, the Turamahac and Canadian poplar, arbor-vitæ, common yew, black and common dwarf oak, American ash, common hazel, sycamore, sugar, mountain, and Pennsylvanian maple, oriental arbutus, American alder, and common willow; these, with the Canadian elder, small fruited crab, and Pennsylvanian cherry-trees, constituted the forests, which may be considered rather as encumbered, than adorned, with underwood." (Vancouver, *A Voyage of Discovery to the North Pacific Ocean and Round the World*, i. 249.)

[4] Alexander Mackenzie (1755?–March 12, 1820) is believed to have been born in Inverness, Scotland. At an early age he entered the employ of the Northwest Fur Company, and, coming to America, was first stationed in 1779 at Toronto, and then at Fort Chippewayan, at the head of Lake Athabasca, where he remained for eight years. In January, 1789, he started with a small party of Indians and half-breeds to explore the unknown country to the north. Skirting Great Slave Lake, which was still covered with ice, and floating down the river that has since borne his name, he reached in six weeks the shores of the Arctic Sea, whence he returned the same season to his post on Lake Athabasca. After a year spent in England studying astronomy and surveying in preparation for a more difficult journey, in which he hoped to cross the continent, Mackenzie left Fort Chippewayan on July 10, 1792, and after great hardships and many dangers reached on June 22, 1793, the shores of the Pacific Ocean, in latitude 52° 25′ north. Fearing an attack of hostile Indians, he started homeward the following day, and retraced his steps to the east.

Having amassed a comfortable fortune in the fur trade, Mackenzie returned to England in 1801, and published the account of his travels. He was knighted in 1802, and remained during the remainder of his life in the service of the Company in whose employ he had gained fame as one of the most undaunted and successful explorers who have trod the North American continent.

[5] "Here the timber was also very large; but I could not learn from our conductors why the most considerable hemlock trees were stripped of their bark to the tops of them. I concluded, indeed, at that time that the inhabitants tanned their leather with it. Here were also the largest and loftiest elder and cedar trees that I had ever seen." (Mackenzie, *Voyages from Montreal on the River St. Lawrence and through the Continent of North America to the Frozen and Pacific Oceans in the years 1789 and 1793*, 317.)

"The other wood was hemlock, white birch, two species of spruce, firs, willows, etc." (*Ibid.* 363.)

[6] See *History of the Expedition under Command of Lewis and Clark*, ed. Coues, iii. 830.

[7] An unfortunate confusion between the names of the two Hemlocks of western North America has long existed. Bongard, in his *Végétation de l'Isle de Sitka*, first described three species of Pinus collected by Mertens on Baranoff Island, near the town of Sitka. This paper was read in May, 1831, before the Academy of St. Petersburg, and was first published as a pamphlet in August, 1832, the volume of the Memoirs of the St. Petersburg Academy, in which it finally appeared, being dated 1833. One of these species, *Pinus Sitchensis*, is the *Picea Sitchensis* of Carrière; another, *Pinus Canadensis*, mistaken for the Hemlock of eastern North America, is clearly the western Hemlock; the third species, *Pinus Mertensiana* n. sp. with *folia* "*obtusiuscula, supra plana, subtus nervo medio prominulo, integerrima*," and "*strobili solitarii, sessiles, oblongi, obtusi*, 1½, *pollicares pl. min.*" cannot be referred to the same plant as Bongard's *Pinus Canadensis*, although such a reference, first adopted by Gordon in 1858, after the introduction of the western Hemlock into English gardens, has been accepted by all subsequent authors who have written on this tree. The fact, however, that there are two species of Hemlock on Baranoff Island appears to have escaped the attention of botanists from Merten's time until the summer of 1897, when in company with Messrs. William M. Canby and John Muir I found the *Tsuga Pattoniana* of Sénéclauze, Engelmann, etc., growing near the town of Sitka with the so-called *Tsuga Mertensiana*, and it became at once clear that Bongard's description of *Pinus Mertensiana* could belong only to the Patton Spruce. Therefore this tree should be known as *Tsuga Mertensiana*, while another name must be found for Bongard's *Pinus Canadensis*. That of Rafinesque, published in 1832, *Abies heterophylla*, is the next oldest name. The possibility of identifying the tree described by Rafinesque under this name has usually been doubted, but his description was based on the following account in the journal of Lewis and Clark: —

"The second is a much more common species, and constitutes at least one half of the timber in this neighborhood. It seems to resemble the spruce, rising from 160 to 180 feet, and being from four to six in diameter, straight, round, and regularly tapering.

The bark is thin, of a dark color, much divided in small longitudinal interstices; the bark of the boughs and young trees is somewhat smooth, but not equal (in this respect) to the balsam-fir; the wood is white, very soft, but difficult to rive; the trunk is a simple, branching, and diffuse stem, not so proliferous as pines and firs usually are. It puts forth buds from the sides of the small boughs, as well as from their extremities, the stem terminates, like the cedar, in a slender pointed top. The leaves are petiolate; the foot-stalks short, acerose, rather more than half a line in width, and very unequal in length; the greatest length seldom exceeds one inch, while other leaves, intermixed on every part of the bough, do not exceed a quarter of an inch. The leaf has a small longitudinal channel on the upper disk, which is of a deep and glossy green, while the under disk is of a whitish green. It yields but little rosin. What is remarkable, the cone is not longer than the end of a man's thumb; it is soft, flexible, of an ovate form, and produced at the ends of the small twigs." (Ed. Coues, iii. 830.)

There is no other tree in the forests of Pacific North America but this Hemlock to which this description can be applied, and there seems to be no other course but to adopt Rafinesque's specific name and call the western Hemlock *Tsuga heterophylla* and Patton's Spruce *Tsuga Mertensiana*, although such a change of names will certainly prove highly confusing.

[1] See xi. 41.

[2] See Fowler, *Gard. Chron.* 1872, 75 (as *Abies Albertiana*). — Dunn, *Jour. R. Hort. Soc.* xiv. 78 (as *Abies Albertiana*).

In the eastern United States *Tsuga heterophylla* has not yet shown its ability to endure the hot dry summers or the changes of our uncertain winter climate, and rarely survives here more than a few years.

EXPLANATION OF THE PLATE.

PLATE DCV. TSUGA HETEROPHYLLA.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, upper side, with its ovules, enlarged.
8. A pistillate flower, lower side, with its bract, enlarged.
9. A fruiting branch, natural size.
10. A cone-scale, lower side, with its bract, natural size.
11. A cone-scale, lower side, with its bract, natural size.
12. A cone-scale, upper side, with its seeds, natural size.
13. Seeds, enlarged.
14. Vertical section of a seed, enlarged.
15. An embryo, enlarged.
16. Cross section of a leaf, magnified fifteen diameters.
17. Winter branch-buds, enlarged.
18. Seedling plants, natural size.

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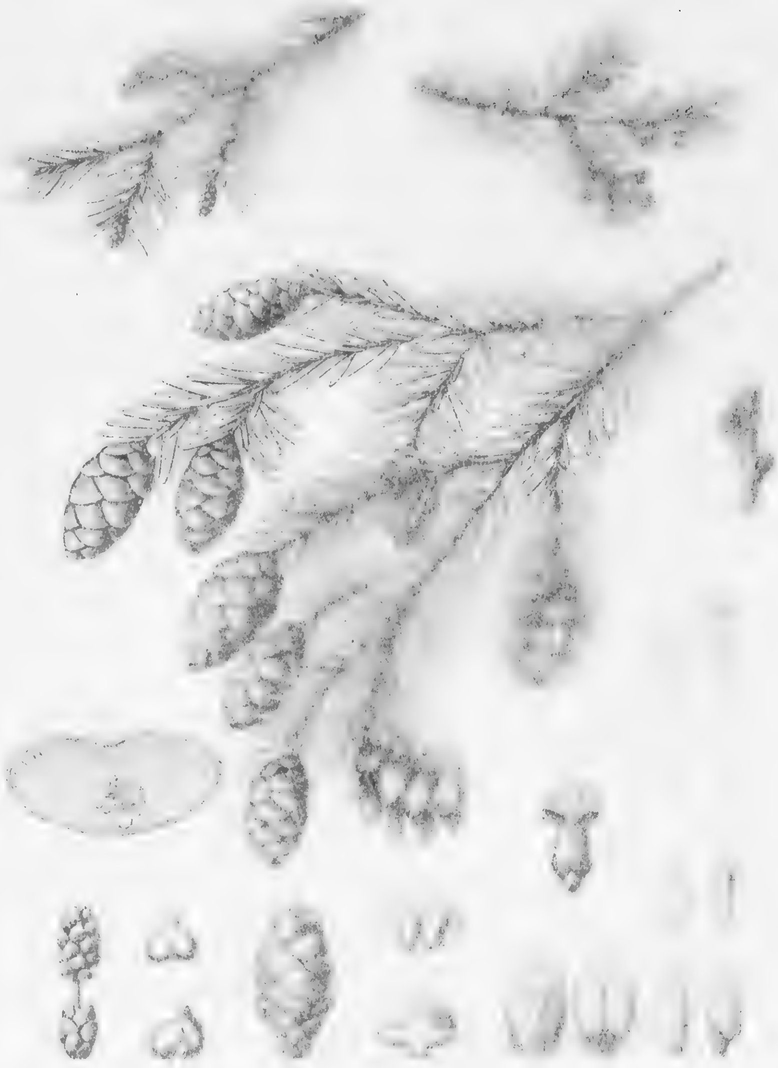

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[illegible] bark is thin, of a dark color, much divided in small longitudinal [illegible], the bark of the boughs and young trees is somewhat smooth, but not equal (in this respect) to the balsam-fir; the wood is white, very soft, but difficult to rive; the trunk is a simple, branching, and diffuse stem, not so proliferous as pines and firs usually are. It puts forth buds from the sides of the small boughs, as well as from their extremities, the stem terminates, like the cedar, in a slender pointed top. The leaves are petiolate, the foot-stalks short, accrose, rather more than half a line in width, and very unequal in length, the greatest length seldom exceeds one inch, while other leaves [illegible] every part of the bough, do not exceed a quarter of an inch. [illegible] has a small longitudinal [illegible] [illegible] longer than the end of a man's thumb; it is soft, flexible, of an ovate form, and produced at the ends of the small twigs." (Ed. Coues, iii. 830.)

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5. A branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. [illegible]
8. [illegible]
9. A fruiting branch, natural size.
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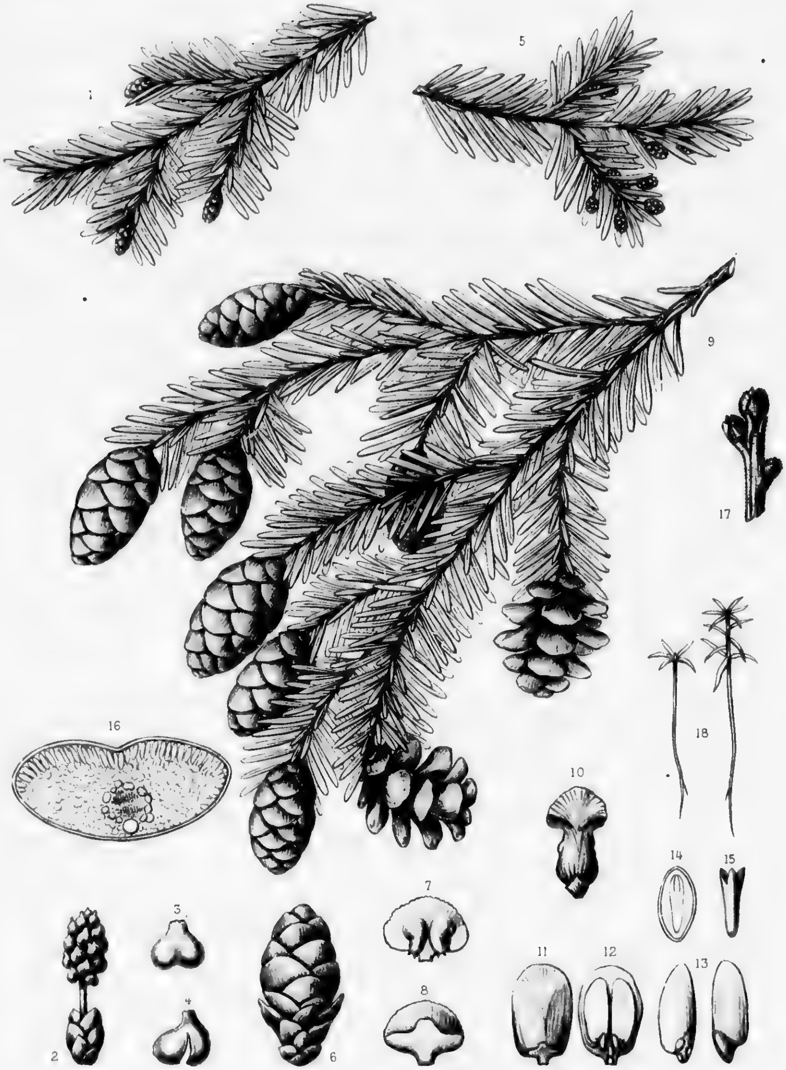
18. Seedling plant [illegible]



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TSUGA HETEROPHYLLA, Sarg.

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TSUGA MERTENSIANA.

Mountain Hemlock. Patton Spruce.

CONES oblong, cylindrical, sessile, their scales oblong-obovate, longer than broad. Leaves bluntly pointed, stomatiferous on both surfaces.

Tsuga Mertensiana (not Carrière).

Pinus Mertensiana, Bongard, *Fl. Sitcha*, 54 (August, 1832); *Mém. Phys. Math. Nat.* pt. ii. *Acad. Sci. St. Pétersbourg*, ii. 163 (*Fl. Sitcha*). — Hooker, *Fl. Bor.-Am.* ii. 164. — Endlicher, *Syn. Conif.* 111. — Ledebour, *Fl. Ross.* iii. 668. — Dietrich, *Syn.* v. 394.

Abies Mertensiana, Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 211 (1850). — A. Murray, *Proc. R. Hort. Soc.* iii. 145.

Abies Pattoniana, A. Murray, *Rep. Oregon Exped.* 1, t. 4, f. 2 (1853); *Edinburgh New Phil. Jour.* n. ser. i. 291, t. 9, f. 1–7. — Lawson, *Pinetum Brit.* ii. 157, t. 22, f. — Hoopes, *Evergreens*, 172. — K. Koch, *Dendr.* ii. pt. ii. 253. — Gordon, *Pinetum*, ed. 2, 30, 421. — Hall, *Bot. Gazette*, ii. 94. — Veitch, *Man. Conif.* 116, f. 31, 32. — Lauche, *Deutsche Dendr.* ed. 2, 96.

Abies Mertensia, Carrière, *Traité Conif.* 232 (1855).

? **Picea Californica**, Carrière, *Traité Conif.* 261 (1855).

Abies Hookeriana, A. Murray, *Edinburgh New Phil. Jour.* n. ser. i. 289, t. 9, f. 11–17 (1855). — Lawson, *Pinetum Brit.* ii. 153, t. 21, 22, f. 1–22. — (Nelson) Senilis, *Pinaceæ*, 31. — Veitch, *Man. Conif.* 115, t. 32.

Abies Williamsonii, Newberry, *Pacific R. R. Rep.* vi. pt. iii. 53, t. 7, f. 19 (1857). — Cooper, *Am. Nat.* iii. 412.

Abies Pattonii, Gordon, *Pinetum*, i. 10 (1858); Suppl. 6. — Henkel & Hochstetter, *Syn. Nadelh.* 151 (excl. syn. *Abies trigona*).

Tsuga Pattoniana, Sénéclauze, *Conif.* 21 (1867). — Engelmann, *Brewer & Watson Bot. Cal.* ii. 121; *Gard. Chron.* n. ser. xvii. 145. — Kellogg, *Trees of California*, 37. — Regel, *Russ. Dendr.* ed. 2, pt. i. 40. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 208. — Mayr, *Wald. Nordam.* 356, t. 6, f. — Beissner, *Handb. Nadelh.* 407, f. 112, 113. — Masters, *Jour. R. Hort. Soc.* xiv. 255. — Hansen, *Jour. R. Hort. Soc.* xiv. 448 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 11, f. 5, A. — Coville, *Contrib. U. S. Nat. Herb.* iv. 223 (*Bot. Death Valley Exped.*). — Lemmon, *West-American Cone-Bearers*, 53; *Bull. Sierra Club*, ii. 160, t. 23 (*Conifers of the Pacific Slope*).

Tsuga Hookeriana, Carrière, *Traité Conif.* ed. 2, 252 (1867). — Sénéclauze, *Conif.* 21. — Hansen, *Jour. R. Hort. Soc.* xiv. 446 (*Pinetum Danicum*). — Lemmon, *Erythea*, vi. 78.

Pinus Pattoniana, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 429 (1868). — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 211, 212, t. 23, f. 2.

Tsuga Roezlii, Carrière, *Rev. Hort.* 1870, 217, f. 40. — Masters, *Jour. R. Hort. Soc.* xiv. 256.

Picea (Tsuga) Hookeriana, Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 89 (1874).

Pinus Hookeriana, W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 211, 212, t. 23, f. 1 (1875).

Hesperopeuce Pattoniana, Lemmon, *Rep. California State Board Forestry*, iii. 126, t. 12 (*Cone-Bearers of California*) (1890).

Tsuga Pattoniana, var. **Hookeriana**, Lemmon, *West-American Cone-Bearers*, 54 (1895); *Bull. Sierra Club*, ii. 160 (*Conifers of the Pacific Slope*). — Gorman, *Pittonia*, iii. 69.

A tree, usually from seventy to one hundred but occasionally one hundred and fifty feet in height, with a slightly tapering trunk four or five feet in diameter,[1] or at high elevations nearly stemless, with stout wide-spreading almost prostrate branches. In youth and often on the margins of groves, or in other positions where it can enjoy abundant space for the free development of its lower limbs, it is clothed for a century or two from top to bottom with gracefully pendent slender branches, which are furnished with drooping frond-like lateral branches with erect ultimate branchlets, and form an open pyramid surmounted by the long drooping leading shoots; or when crowded in the forest the tall trunk, naked often for two thirds of its length, bears only a short narrow pyramidal crown. The bark of the trunk is from an inch to an inch and a half in thickness and deeply divided into connected rounded ridges broken into thin closely appressed scales, and is dark cinnamon-red with blue or purple shadings. The buds are acute and about an eighth of an inch in length, with light chestnut-brown scales which in the outer ranks are furnished on the back with conspicuous midribs produced into slender deciduous awl-like tips. The branchlets are thin and flexible, or stout and rigid when the tree has grown slowly in exposed situations at high elevations; for two or three years they are light reddish brown and covered with short pale dense pubescence which disappears as the thin bark begins to break up into loose scales, and at the end of four or five years they become grayish brown and usually very scaly. The leaves, which stand out from all sides of the branches and are remote on leading shoots and crowded on the short lateral erect branchlets peculiar to this species, are rather abruptly narrowed into nearly straight or slightly twisted petioles, and are raised on persistent bases as long or rather longer than the petioles; they are rounded and occasionally obscurely grooved, or on young plants sometimes more conspicuously grooved on the upper surface and rounded and slightly ribbed on the lower surface, entire, rather bluntly pointed at the apex, often more or less curved, stomatiferous above and below with about eight rows of stomata on each surface, light bluish green or on some individuals pale blue, from half an inch to an inch in length, about one sixteenth of an inch in width, and irregularly deciduous during their third and fourth years. The staminate flowers are about one sixth of an inch long, with violet-blue anthers furnished with very short basal projections, and are borne on slender pubescent drooping stems from one quarter to nearly one half of an inch in length from buds produced in the axils of the crowded leaves near the extremities of the short lateral branchlets. The pistillate flowers are erect, about a quarter of an inch in length, with delicate lustrous dark purple or yellow-green bracts gradually narrowed above into slender and often slightly reflexed tips. The cones, which are produced in great profusion on all the upper branches, are sessile, cylindrical-oblong, narrowed toward the blunt apex and somewhat toward the base, erect until more than half grown, pendulous or rarely erect at maturity,[1] from five eighths of an inch to three inches in length[2] and from three quarters of an inch to an inch in diameter, with thin delicate scales which are as broad as they are long or somewhat narrower, gradually contracted from above the middle to the wedge-shaped base, rounded at the slightly thickened and more or less erose margin, striate and puberulous on the outer surface, and usually bright bluish purple or occasionally pale yellow-green in the exposed parts until the cones ripen, adjacent trees often producing exclusively cones of one and of the other color, especially those growing on the mountains of Washington and Oregon, where the form with yellow cones appears to be more abundant than in other parts of the country; the scales are four or five times as long as their bracts, which are rounded, rather abruptly contracted at the apex into short points, wedge-shaped and thickened below, with prominent midribs, dark purple above the middle and brown below, or on the form with yellow-green cone-scales brown throughout; at maturity the scales turn dark brown and spread nearly at right angles to the axis of the cone or become much reflexed. The seeds are light brown, one eighth of an inch long, and often marked on the surface next their scale with one or two large resin vesicles; their wings are nearly half an inch in length, broadest above the middle, gradually narrowed below and only slightly or not at all oblique at the rounded apex.

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[1] The largest recorded measurement of this tree is of a specimen growing on the California Sierras near the margin of Lake Hollow, at an elevation of nine thousand two hundred and fifty feet, which Muir found to be nineteen feet seven inches in circumference at four feet above the ground. (See Muir, *The Mountains of California*, 207.)

Tsuga Mertensiana is usually a tree of high altitudes, growing on exposed ridges and slopes at the upper border of the forest, where it is often completely buried in snow during many months of every year, and where its tough and flexible branches and slender leading shoots resist for centuries the fiercest mountain gales. In such exposed positions it forms low dense thickets, with wide-spreading limbs clinging close to the ground, but on more sheltered slopes at lower altitudes it sends up tall and stately stems and sometimes forms nearly pure forests of considerable extent. In southeastern Alaska, where it finds its most northerly home,[1] the Mountain Hemlock grows on the coast mountains up to elevations of nearly two thousand feet, and occasionally descends to the level of the sea;[2] southward it ranges along the coast mountains of British Columbia[3] to the Olympic Mountains of Washington, usually growing only at elevations of more than two thousand five hundred feet above the sea. It is abundant on the western slopes of the Selkirk Mountains in the interior of southern British Columbia, where it is a conspicuous feature in the forests of *Tsuga heterophylla, Abies lasiocarpa, Pinus albicaulis,* and *Picea Engelmanni;* from the Selkirk Mountains it ranges to northern Montana[4] and to the Cœur d'Alene and Bitter Root Mountains of northern Idaho;[5] southward it extends to the Powder River Mountains, and along the Cascade Mountains of Washington and Oregon, growing with *Abies lasiocarpa* usually between five and seven thousand feet above the sea on ridges and along the margins of alpine meadows in groves of exquisite beauty,[6] and pushing the advance guard of the forest to the edge of living glaciers, while at lower altitudes it attains a large size and mingles with *Abies amabilis* and occasionally with hardy stragglers from the forest of *Abies nobilis,* which clothes the lower slopes of these mountains.[7] On the southern part of the Cascade Range it reaches an altitude of eight thousand feet above the sea, and a thousand feet lower and below Crater Lake, in latitude 42° 55′, it forms the noblest forest of this Hemlock which has yet been seen, with trees often one hundred and fifty feet in height and from three to five feet in trunk diameter. It is common on Mt. Shasta, in northern California, where it forms extensive groves near the timber-line at eight thousand feet above the sea, and occurs near the high summits of the Siskiyou Mountains, and at an elevation of eight thousand feet on the mountains in the rear of Crescent City;[8] on the Sierra Nevada it forms groves, usually on northern slopes and between elevations of from nine thousand to ten thousand feet above the sea, near the timber-line of all the high peaks, probably finding its most southerly home in the cañon of the south fork of King's River.[9]

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[1] Apparently the erect cones are found only on trees which have grown slowly in exposed situations, and their position is evidently due to the thickness of the short lateral branchlets on which they are terminal and which are sometimes so rigid that the weight of the cones does not make them pendent. Trees with erect cones seem to have been first noticed by Mr. M. W. Gorman, who found them, in 1895, small and stunted on slopes and cliffs near the snow-line at altitudes of from three thousand to three thousand five hundred feet above the sea on the mountains near Yes Bay, Alaska. Similar trees have been seen by Mr. Gorman on the east slope of the Cascade Mountains above Lake Chelan in Washington at elevations of seven thousand feet; and I have seen a small tree at the sea-level near Sitka which displayed the same peculiarity.

[2] The cones of *Tsuga Mertensiana* are usually from two to two and a half inches in length. The smallest I have seen were gathered in August, 1895, by Professor S. V. Piper on dry ridges of Mt. Rainier in Washington at an elevation of seven thousand feet above the sea.

The wood of *Tsuga Mertensiana* is light, soft, not strong, close-grained, and susceptible of receiving a good polish; it is pale brown or red, with thin nearly white sapwood, and contains thin inconspicuous bands of small summer cells and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4454, a cubic foot weighing 27.76 pounds. It is occasionally manufactured into lumber.[10]

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[1] See F. Kurtz, *Bot. Jahrb.* xix. 425 (*Fl. Chilcatgebietes*).

The most western point on the Alaska coast where *Tsuga Mertensiana* has been seen is Baranoff Island, where it was first discovered and where it grows with *Tsuga heterophylla* and *Picea Sitchensis.* It probably extends, however, to the neighboring Chichagof Island and possibly to the westward of Cross Sound. It is common up to the snow-line on the mountains at the head of the Lynn Canal one hundred miles north of Sitka in latitude 60° north, the most northerly station from which this tree has been reported (G. M. Dawson, *Garden and Forest,* i. 59; *Rep. Geolog. Surv. Can.* n. ser. iii. pt. i. Appx. i. 189 B. — Macoun, *Rep. Geolog. Surv. Can.* n. ser. iii. pt. i. Appx. iii. 226 B).

[2] The only stations at the sea-level for this tree which are known to me are Barnnoff Island and the shores of Yes Bay in latitude 55° 54′ north, where it was first collected by Mr. M. W. Gorman.

[3] Macoun, *Garden and Forest,* ii. 525; *Cat. Can. Pl.* pt. iv. 362.

[4] *Tsuga Mertensiana* was found in northern Montana by Mr. H. B. Ayres in September, 1893, on the divide between Thompson and Little Bitter Root Creeks, at an elevation of between six and seven thousand feet above the sea-level.

[5] *Tsuga Mertensiana* appears to have been first noticed in Idaho by Mr. Sereno Watson, who found it in 1880 on the Lolo Trail toward the northern extremity of the Bitter Root Range. In Idaho it is confined to the high divides of the Bitter Root and Cœur d'Alene Mountains from that of the Clearwater River on the south, where it is said to form more than seventy-five per cent. of the forest growth, northward to the upper St. Joseph and to the divide between the St. Joseph and Cœur d'Alene Rivers, being more abundant on the Clearwater and the St. Joseph than farther north. (See Leiberg, *Contrib. U. S. Nat. Herb.* v. 53.)

[6] In August, 1896, I found *Tsuga Mertensiana* growing with *Tsuga heterophylla* on the east slope of the Cascade Mountains of Washington, near the mouth of the Cascade tunnel on the line of the Great Northern Railroad, at the remarkably low elevation of two thousand two hundred feet.

[7] See Piper, *Garden and Forest,* iv. 382, f. 63; also *Garden and Forest,* x. 1, f. 1, 2.

[8] *Teste* A. J. Johnson.

[9] *Teste* John Muir.

[10] The inaccessibility of the alpine slopes which are the usual home of this tree has protected it from the lumberman, although the wood has considerable value for purposes of construction. On

The bark contains enough tannic acid to make it commercially valuable as a tanning material.

Tsuga Mertensiana was discovered on Baranoff Island in the neighborhood of the town of Sitka in 1827 by K. H. Mertens.[1] It was next found on the mountains south of the Fraser River[2] in 1851 by John Jeffrey,[3] by whom it was introduced into European gardens, where, as well as in those of the eastern United States, it has proved hardy. In cultivation, however, *Tsuga Mertensiana* grows very slowly,[4] and, although it has already produced its cones in England,[5] gives little promise of ever assuming the airy grace of habit which makes it the loveliest cone-bearing tree of the American forest.

Kuiu Island, Alaska, small quantities of lumber known as red spruce have been made from it. (See Gorman, *Pittonia*, iii. 68.)

[1] Karl Heinrich Mertens (May 17, 1796–September 17, 1830) was the son of Dr. Franz Karl Mertens, who was the head of an institution of learning in Bremen and the author of botanical papers, and who is commemorated in the genus *Mertensia*. He was born in Bremen, where he received his early education, and acquired a fondness for natural history, especially botany, which he studied later in Paris with Jussieu, Desfontaines, Lamarck, and Mirbel, and where he made the acquaintance of Dawson Turner, by whom he was invited to London and introduced to Robert Brown, Sir Joseph Banks, and the elder Hooker. Returning to Germany in 1817, he commenced the study of medicine in Göttingen and then in Halle, where he took his doctor's degree in 1820, and began to practice his profession in Berlin, which, however, he soon left to make his home in his native city. An intense love of natural history and a desire for travel made the prospect of a quiet professional life in Bremen unbearable, and Mertens went to St. Petersburg in the hope of being appointed naturalist to the exploring expedition which was fitted out there under command of Kotzebue. Failing to obtain this position, he remained for two years in Russia practicing his profession, and finally in the spring of 1826 was made naturalist and physician to the expedition which sailed that year under Captain Lutkí on the Sémiavine to make a scientific journey of exploration around the world. During the next four years Mertens visited England, Teneriffe, Rio de Janeiro, Cape Horn, Valparaiso, the coast of Alaska, Kamtschatka, the Caroline Islands, Manila, the Cape of Good Hope, and St. Helena. Returning to St. Petersburg, he presented to the Academy of Sciences of that city a number of papers chiefly devoted to the invertebrates collected during his journey. He was still engaged in studying his collections when he joined, in 1830, his old commander Lutkí on a cruise along the coast of France and Ireland, during which he contracted a nervous fever, from which he died shortly after his return to Russia.

On Baranoff Island Mertens discovered, in addition to the Hemlock-tree which bears his name, a number of other interesting plants which were described by Bongard in his paper on *La Végétation de l'Ile de Sitka*, based on Mertens's collection on that island and published in the second volume of the *Mémoires de l'Académie des Sciences de St. Pétersbourg*. A communication from Mertens on the flora of Karagin Island off the coast of Kamtschatka and the shores of Behring Strait, published in the third volume of *Linnæa*, appears to have been his only botanical paper. (For a sketch of Merten's career see *Voyage autour du Monde exécuté par ordre de sa Majesté l'Empereur Nicholas I. sur la Corvette Le Sémiavine dans les Années* 1826, 1827, 1828 *et* 1829, *par Frédéric Lutki*, iii. 337.)

[2] "*Abies sp.* No. 430. Found on the Mt. Baker range of mountains. This species makes its appearance at the point where *A. Canadensis* disappears, that is at an elevation of about five thousand feet above the sea; from that point to the margin of perpetual snow it is found. Along the lower part of its range it is a noble looking tree, rising to the height of one hundred and fifty feet, and thirteen and one half feet in diameter. As it ascends the mountains it gets gradually smaller, until at last it dwindles into a shrub of not more than four feet high. Leaves solitary, dark green above, silvery beneath, flat and rounded at their points, thickly placed round the branches. Cones about an inch long, produced at the points of the branches. Branches pendulous. Bark rough, of a grayish color. Timber hard and very fine in the grain, of a reddish color. Soil on which this tree was growing most luxuriantly was red loam, very stony and moist. If this tree proves undescribed, I hope it will be known under the name of *Abies Pattonii*." (From Report of John Jeffrey read at a meeting of the Oregon Committee, August 24, 1852, and printed in September following in a circular to its subscribers.)

[3] See xi. 41.

[4] Like other alpine trees, *Tsuga Mertensiana* grows slowly. The log in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, from the Cascade Mountains of Oregon, is eighteen inches in diameter inside the bark and one hundred and eighty-five years old, the sapwood being three inches and three quarters in thickness, with ninety-one layers of annual growth. Leiberg found that the trunk of a tree six inches in diameter, which had grown in Idaho in a very exposed position, was seventy-five years old, and trees in the same region which had grown under the most favorable conditions as to soil and situation were nineteen inches in diameter, and from two hundred to two hundred and fifty years old. (See *Contrib. U. S. Nat. Herb.* v. 53.)

[5] Masters, *Gard. Chron.* ser. 3, xii. 10, f. 1; xiii. 659, f. 96.

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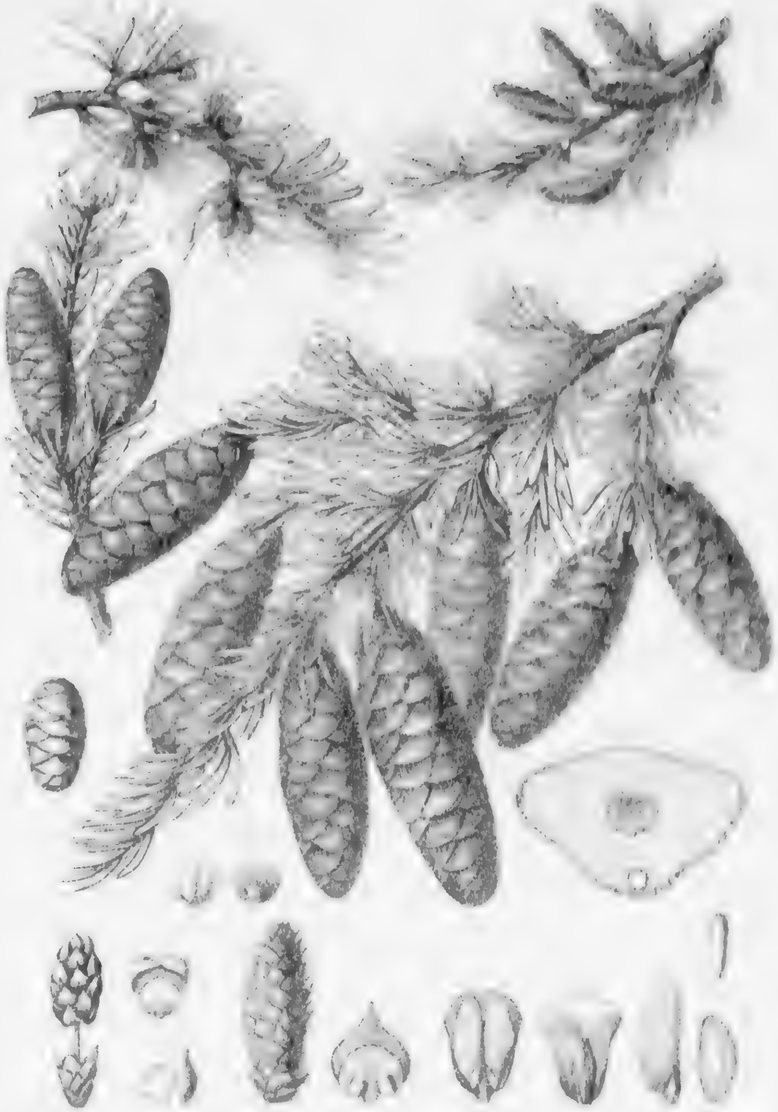
EXPLANATION OF THE PLATE.

PLATE DCVI. TSUGA MERTENSIANA.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
8. A fruiting branch, natural size.
9. Portion of a top of a tree from Baranoff Island with erect cones, natural size.
10. A cone from the Cœur d'Alene Mountains, Idaho.
11. A cone-scale, upper side, with its seeds, natural size.
12. A cone-scale, lower side, with its bract, natural size.
13. A scale of a small Cœur d'Alene cone, upper side, with its seeds, natural size.
14. A scale of a small Cœur d'Alene cone, lower side, with its bract, natural size.
15. A seed, enlarged.
16. Vertical section of a seed, enlarged.
17. An embryo, enlarged.
18. Cross section of a leaf, magnified fifteen diameters.



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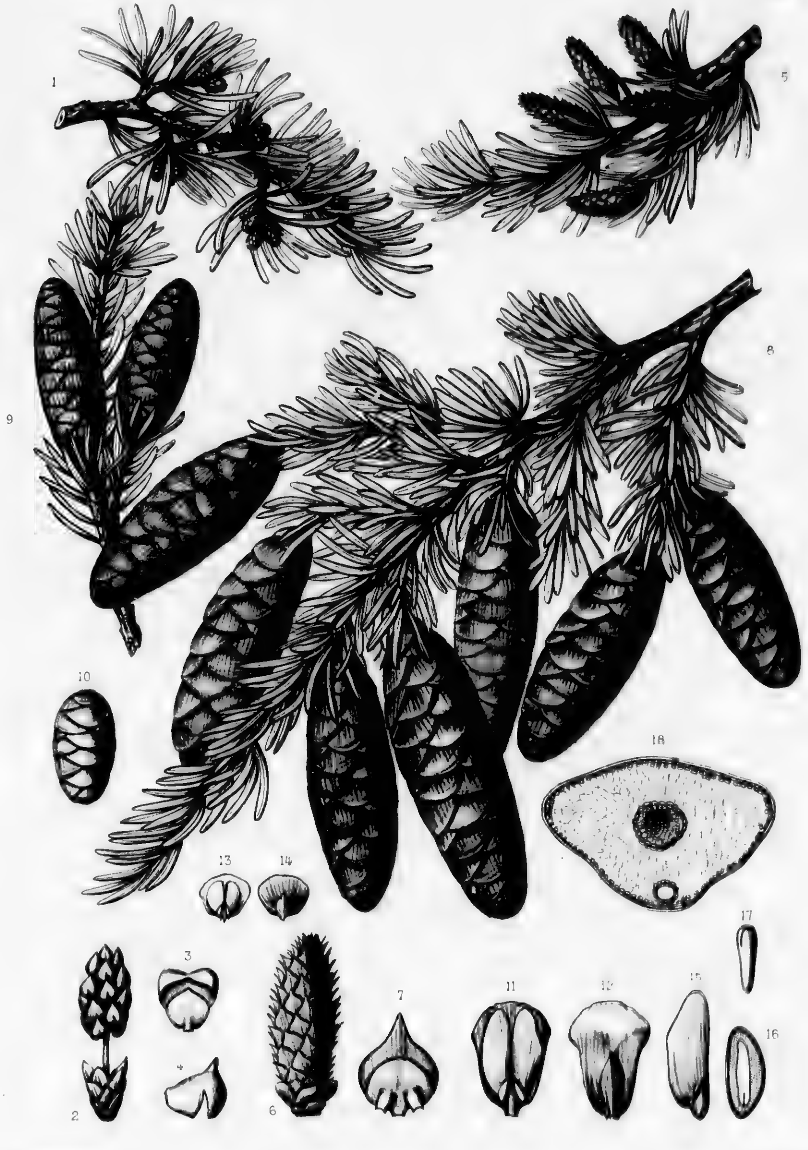
EXPLANATION OF THE PLATE.

Tsuga Mertensiana.

1. A flowering branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A pistillate flower, enlarged.
7. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
8. A fruiting branch, natural size.
9. Portion of a top of a tree from Baranoff Island with [illegible] cones, natural size.
10. A cone from the Cœur d'Alene Mountains, Idaho.
11. A cone-scale, upper side, with its seeds, natural size.
12. A cone-scale, lower side, with its bract, natural size.
13. A scale of a small Cœur d'Alene cone, upper side, with its seeds, natural size.
14. A scale of a small Cœur d'Alene cone, lower side, with its bract, natural size.
15. A seed, enlarged.
16. Vertical section of a seed, enlarged.
17. An embryo, enlarged.
18. Cross section of a leaf, magnified [illegible].



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PSEUDOTSUGA.

Flowers solitary, naked, monœcious; the staminate axillary, stamens indefinite, anther-cells 2, surmounted by a short spur; the pistillate terminal or axillary, their bracts elongated, 2-lobed, aristate, ovules 2 under each scale. Fruit a woody strobile maturing in one season. Leaves flat, petiolate, persistent.

Pseudotsuga, Carrière, *Traité Conif.* ed. 2, 256 (1867). — Bentham & Hooker, *Gen.* iii. 441. — Masters, *Jour. Linn. Soc.* xxx. 35.

Abies (sect. Peucoides), Spach, *Hist. Vég.* xi. 423 (1842).

Pinus (sect. Tsuga), Endlicher, *Gen.* Suppl. iv. pt. ii. 6 (in part) (1847).

Tsuga (sect. Peucoides), Engelmann, *Trans. St. Louis Acad.* ii. 211 (1863). — Eichler, *Engler & Prantl Pflanzenfam.* ii. pt. i. 80 (in part).

Pinus, Baillon, *Hist. Pl.* xii. 44 (in part) (1892).

Pyramidal trees, with thick deeply furrowed scaly bark, hard strong yellow or red wood with spirally marked wood cells and broad dark resinous bands of small summer cells often occupying half the width of the layers of annual growth, slender usually horizontal irregularly whorled branches clothed with slender spreading pendent or rarely erect lateral branchlets forming broad flat-topped masses of foliage, stout wide-spreading roots, and thin tough rootlets. Branch-buds formed in early summer, ovate, acute, from three to five in number, the lateral in the axils of upper leaves and much smaller than the terminal bud, covered with numerous closely imbricated dark chestnut-brown spirally disposed scales rounded, entire, or somewhat erose on the thin often scarious margins, increasing in size from the bottom of the bud upward, the two outer minute, lateral, and opposite, the inner thin, accrescent, silvery white, withering and sometimes persistent on the base of the branch for three or four years and in falling marking it with ring-like scars. Leaves densely crowded in short clusters when they first emerge from the bud, spirally disposed but often appearing two-ranked on vigorous sterile branches by the twisting of their slender petioles, spreading nearly at right angles with the branch, straight or more or less incurved, flat, rounded and obtuse or acuminate at the callous apex, marked on the upper surface with a conspicuous groove and on the lower surface with a band of numerous rows of stomata on each side of the prominent midrib, containing two lateral resin ducts close to the epidermis on the lower side, articulate on low transversely oval concave ultimately woody pulvini, persistent for many years and in drying. Flowers appearing in early spring from buds formed the previous summer on branches of the year, erect, surrounded by conspicuous involucres of the lustrous oblong bud-scales rounded at the apex, increasing in size from below upward, the inner becoming much enlarged and silvery white. Staminate flowers axillary and scattered along the branchlets, oblong-cylindrical, raised on short, ultimately elongated stalks, composed of numerous spirally arranged short-stalked globose anthers opening obliquely, their connectives terminating in short spurs; pollen-grains ovoid, subglobose, without air-sacs.[1] Pistillate flowers terminal or in the axils of upper leaves, short-stalked, oblong, composed of numerous ovate rounded spirally imbricated scales much shorter than their narrow acutely two-lobed bracts variously laciniately cut on the margins, with midribs produced into elongated slender tips; ovules two under each scale, inverted, collateral. Cones maturing in one season, ovate-oblong, acute at the apex, rounded at the slightly narrowed base, pendulous on stout peduncles clothed with linear-acute bracts, their scales rounded, concave, rigid, decreasing in size and sterile at both ends of the cone, spreading at maturity almost at right angles with its axis, persistent; bracts exserted, two-lobed, the lobes spreading, acuminate, their prominent midribs produced into long stiff linear lanceolate flattened awns, rigid and woody at maturity, those at the base of the cone destitute of scales, becoming linear-lanceolate by the gradual suppression of their lobes.[1] Seeds geminate, reversed, attached at the base in shallow depressions on the inner face of the cone-scales, nearly triangular, rather longer than broad, full, rounded, and dark-colored on the upper face, more or less flattened and pale on the lower face, destitute of resin vesicles, in falling bearing away portions of the membranaceous lining of the scale forming oblong wing-like ultimately deciduous attachments, and enveloping the upper side of the seeds in a dark covering adnate to the testa; testa of two coats, the outer thick and crustaceous, the inner thin and membranaceous. Embryo axile in conspicuous fleshy albumen; cotyledons from six to twelve, usually seven or eight, stomatiferous on the upper surface.

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[1] Engelmann, *Brewer & Watson Bot. Cal.* ii. 119.

Pseudotsuga is intermediate in character between Tsuga and Abies, resembling the former in its petioled leaves but differing from it in the exserted bracts of the cone-scales and in the absence of resin vesicles on the seeds, and from the latter in the spurred connectives of the anthers, and in the pendulous cones with persistent cone-scales. The genus is represented by three species; one is widely distributed over western North America from about latitude 53° north in British Columbia to northern Mexico; the second is confined to the dry sides of cañons on the mountains of southwestern California, and the third, which is still little known, grows in Japan.[2]

Pseudotsuga produces hard durable valuable wood which is distinguished from that of other coniferous trees by its numerous spirally marked wood cells, and one of its species is one of the largest and most important timber-trees of the world.

Pseudotsuga is not known to be seriously injured by insects[3] or fungal diseases.[4]

Like the other Abietineæ, trees of this genus can easily be raised from seeds, and *Pseudotsuga mucronata*, the type of the genus, is one of the most splendid ornaments of the parks of temperate countries.

The generic name, a barbarous combination of a Greek with a Japanese word, signifies the relationship of these trees with the true Hemlocks.

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[1] See Lloyd, *Bull. Torrey Bot. Club*, xxv. 90, t. 327 (On an Abnormal Cone in the Douglas Spruce).

[2] *Pseudotsuga Japonica.*

Tsuga (*Pseudotsuga*) *Japonica*, Shirasawa, *Tōkyō Bot. Mag.* ix. 86, t. 3 (1895).

The Japanese Pseudotsuga, which was discovered only a few years ago by Mr. Homi Shirasawa near Yoshino, in the province of Kii, at an elevation of about two thousand feet above the sea, is distinguished by shorter and broader leaves and smaller cones than those of the American species, while the bracts of the cone-scales appear strongly reflexed in Mr. Shirasawa's plate. It is described as a tree from forty-five to sixty feet in height, with an erect straight trunk, horizontally spreading branches, and spire-like top, growing in forests of Birches, Hemlocks, Oaks, Magnolias, and Acanthopanax. (See *Garden and Forest*, viii. 129. — *Gard. Chron.* ser. 3, xvii. 462.)

[3] Very little is yet known of the insects which attack Pseudotsuga in its native forests, and there is no record of their materially injuring cultivated trees. The species of Scolytitax, among them being *Scolytus unispinosus*, Le Conte, are known to burrow under the bark of *Pseudotsuga mucronata* in California, and it is probable that several of the insects which obtain their food from different species of Picea and Abies will be found to live also on Pseudotsuga. The larvæ of the small moth *Grapholitha bracteatana*, Fernald, has been reported as injurious to its cones in Oregon, nearly half the crop of the seeds of 1897 having been destroyed in one locality by this insect, and by the larvæ of a cecidomyiid fly which accompanies it. (See *Bull.* No. 10, n. ser. *Div. Entomolog. U. S. Dept. Agric.* 1898, 98.)

[4] Pseudotsuga appears to suffer little in the United States from the attacks of fungi, where hardly a dozen species have been noted on it, and none of these are known to cause any serious disease or to be confined especially to this host. Possibly a species of Peridermium which occurs on *Pseudotsuga mucronata* in Colorado may prove injurious to this tree, but its fungal characters are not yet well understood. Two species of fungi, however, are said to do considerable damage to *Pseudotsuga mucronata* when cultivated in Europe. In 1888 Von Tubeuf described a *Botrytis Douglasii* which appeared in Germany in widely separated localities, and caused the young leaves to wither and shrivel up. This disease has been occasionally noticed since, although mycologists are inclined to doubt whether *Botrytis Douglasii* is really distinguished from *Botrytis cinerea*, Persoon. Oudemans has recently described a mould, *Oospora Abietum*, which in Holland injures the leaves of *Pseudotsuga mucronata* and of different species of Picea.

CONSPECTUS OF THE NORTH AMERICAN SPECIES.

Leaves usually rounded and obtuse at the apex, dark yellow-green or rarely blue-green; cones small, their bracts much exserted . . . . 1. P. MUCRONATA.

Leaves acuminate at the apex, bluish gray; cones large, their bracts slightly exserted . . . . 2. P. MACROCARPA.

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PSEUDOTSUGA MUCRONATA.

Douglas Spruce. Red Fir.

Leaves usually rounded and obtuse at the apex, dark yellow-green or rarely blue-green. Cones small, their bracts much exserted.

Pseudotsuga mucronata, Sudworth, *Contrib. U. S. Nat. Herb.* iii. 266 (1895).

Pinus taxifolia, Lambert, *Pinus*, i. 51, t. 33 (not Salisbury) (1803). — Willdenow, *Spec.* iv. pt. i. 505. — Pursh, *Fl. Am. Sept.* ii. 640. — Sprengel, *Syst.* iii. 885. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 31.

Abies taxifolia, Poiret, *Lamarck Dict.* vi. 523 (not *Pinus taxifolia*, Salisbury) (1804). — *Nouveau Duhamel*, v. 293. — Presl, *Epimel. Bot.* 237. — Torrey & Gray, *Pacific R. R. Rep.* ii. 130.

Abies mucronata, Rafinesque, *Atlant. Jour.* 120 (Autumn, 1832); *New Fl.* i. 38. — Endlicher, *Syn. Conif.* 126. — Carrière, *Traité Conif.* 267.

Abies mucronata, var. **palustris**, Rafinesque, *Atlant. Jour.* 120 (Autumn, 1832); *New Fl.* i. 38. — Endlicher, *Syn. Conif.* 126. — Carrière, *Traité Conif.* 268.

Abies Douglasii, Lindley, *Penny Cycl.* i. 32 (1833). — Lawson & Son, *Agric. Man.* 375. — Loudon, *Arb. Brit.* iv. 2319, f. 2230. — Forbes, *Pinetum Woburn.* 127, t. 45. — Bentham, *Pl. Hartweg.* 57. — Spach, *Hist. Vég.* xi. 423. — Nuttall, *Sylva*, iii. 129, t. 115. — Knight, *Syn. Conif.* 37. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 209. — Torrey, *Pacific R. R. Rep.* iv. pt. v. 141; *Bot. Mex. Bound. Surv.* 210; *Ives' Rep.* pt. iv. 28. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 54, 90, t. 8, f. 20. — Gordon, *Pinetum*, 15. — Cooper, *Pacific R. R. Rep.* xii. pt. ii. 24, 69. — Engelmann, *Am. Jour. Sci.* ser. 2, xxxiv. 330. — Lyall, *Jour. Linn. Soc.* vii. 131, 133, 143. — Henkel & Hochstetter, *Syn. Nadelh.* 155. — (Nelson) Senilis, *Pinuceæ*, 32. — Rothrock, *Pl. Wheeler*, 28, 50; *Wheeler's Rep.* vi. 9. — Hoopes, *Evergreens*, 189. — Lawson, *Pinetum Brit.* ii. 115, t. 17, 18, f. 1–23. — Watson, *King's Rep.* v. 334; *Pl. Wheeler*, 17. — K. Koch, *Dendr.* ii. pt. ii. 255. — Nördlinger, *Forstbot.* 458. — Porter & Coulter, *Fl. Colorado; Hayden's Surv. Misc. Pub.* No. 4, 131. — Veitch, *Man. Conif.* 119, f. 35. — Lauche, *Deutsche Dendr.* ed. 2, 95, f. 19. — Schübeler, *Virid. Norveg.* i. 429, f. 81.

Pinus Douglasii, D. Don, *Lambert Pinus*, iii. t. (1837). — Hooker, *Fl. Bor.-Am.* ii. 162, t. 183. — Antoine, *Conif.* 84, t. 33, f. 3. — Hooker & Arnott, *Bot. Voy. Beechey*, 394. — Endlicher, *Syn. Conif.* 87. — Lawson & Son, *List No. 10, Abietineæ*, 9. — Dietrich, *Syn.* v. 393. — J. M. Bigelow, *Pacific R. R. Rep.* iv. pt. v. 17. — Torrey, *Sitgreaves' Rep.* 173. — Courtin, *Fam. Conif.* 55. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 430. — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 703, t. 49, f. 32, 32 a, 32 b.

Abies Douglasii, var. **taxifolia**, Loudon, *Arb. Brit.* iv. 2319, f. 2231 (not *Abies taxifolia*, Rafinesque) (1838). — Gordon, *Pinetum*, 16. — Henkel & Hochstetter, *Syn. Nadelh.* 156.

Pinus Canadensis β? Hooker, *Fl. Bor.-Am.* ii. 164 (1839).

Pinus Douglasii, var. **taxifolia**, Antoine, *Conif.* 85 (1840–47). — Courtin, *Fam. Conif.* 55 (1858).

Pinus Douglasii, var. **brevibracteata**, Antoine, *Conif.* 84, t. 33, f. 4 (1840–1847).

Picea Douglasii, Link, *Linnæa*, xv. 524 (1841).

Tsuga Douglasii, Carrière, *Traité Conif.* 192 (1855). — Sénéclauze, *Conif.* 20. — Regel, *Russ. Dendr.* ed. 2, pt. i. 40.

Tsuga Douglasii, var. **taxifolia**, Carrière, *Traité Conif.* 192 (1855).

Tsuga Douglasii brevibracteata, Carrière, *Traité Conif.* 193 (1855).

Tsuga Douglasii fastigiata, Carrière, *Traité Conif.* 193 (1855).

Tsuga Lindleyana, Roezl, *Cat. Conif. Mex.* 8 (1857). — Carrière, *Traité Conif.* ed. 2, 254.

Pseudotsuga Douglasii, Carrière, *Traité Conif.* ed. 2, 256 (1867). — Engelmann, *Rothrock Wheeler's Rep.* vi. 257; *Brewer & Watson Bot. Cal.* ii. 120 (excl. var. *macrocarpa*). — Kellogg, *Trees of California*, 38. — Hemsley, *Bot. Biol. Am. Cent.* iii. 190; iv. 89. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 209 (excl. var. *macrocarpa*). — Coulter, *Man. Rocky Mt. Bot.* 431. — Beissner, *Handb. Nadelh.* 411, f. 114, 115 (excl. var. *macrocarpa*). — Masters, *Jour. R. Hort. Soc.* xiv. 245 (excl. var. *macrocarpa*). — Hansen, *Jour. R. Hort. Soc.* xiv. 449. — Koehne, *Deutsche Dendr.* 11 (excl. var. *macrocarpa*), f. 6. — Hempel & Wilhelm, *Bäume und Sträucher*, i. 105, f. 51.

Pseudotsuga Douglasii taxifolia, Carrière, *Traité Conif.* ed. 2, 258 (1867).

Abies mucronata, Carrière, *Traité Conif.* ed. 2, 312 (1867).

Pseudotsuga Douglasii denudata, Carrière, *Traité Conif.* ed. 2, 792 (1867).

Pinus Douglasii, β **pendula**, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 430 (1868).

Pseudotsuga Lindleyana, Carrière, *Rev. Hort.* 1868, 152, t.

Picea (Pseudotsuga) Douglasii, Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 87 (1874).

Pseudotsuga taxifolia, Britton, *Trans. N. Y. Acad. Sci.* viii. 74 (1889). — Lemmon, *Rep. California State Board Forestry*, iii. 130, t. 10, 11 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 56, t. 9; *Bull. Sierra Club*, ii. 161 (*Conifers of the Pacific Slope*). — Leiberg, *Contrib. U. S. Nat. Herb.* v. 50.

Pseudotsuga Douglasii, var. glauca, Mayr, *Wald. Nord-am.* 307, t. 6, f. (1890).

Tsuga taxifolia, Otto Kuntze, *Rev. Gen. Pl.* ii. 802 (1891).

Pseudotsuga taxifolia, var. suberosa, Lemmon, *Erythea*, i. 48 (1893); *West-American Cone-Bearers*, 57; *Bull. Sierra Club*, ii. 161 (*Conifers of the Pacific Slope*).

Pseudotsuga taxifolia, var. elongata, Lemmon, *Erythea*, i. 49 (1893).

A tree, when grown under favorable conditions often two hundred feet in height, with a trunk three or four feet in diameter, and frequently much taller,[1] with a trunk ten or twelve feet in diameter; or in the dry interior of the continent rarely more than eighty or one hundred feet high, with a trunk two or three feet thick, and at high elevations occasionally reduced to a low shrub.[2] The slender crowded limbs, which are densely clothed with long pendulous lateral branches, are horizontal or more or less pendulous below, and erect above; when the tree is young and has grown in an open situation they form a narrow open handsome pyramid with its base resting on the ground, but when the Douglas Spruce is crowded in the forest its trunk, decreasing but slightly in diameter often for a hundred feet above the ground, is generally deprived of its branches for two thirds of its length and is surmounted by a comparatively small narrow head which on very old trees sometimes becomes flat-topped by the lengthening of the upper branches. On young trees the bark is smooth, thin, rather lustrous, and dark gray-brown; beginning to thicken early near the ground and to divide into oblong plates, it ultimately separates into great broad rounded and irregularly connected ridges which are broken on the surface into small thick closely appressed dark red-brown scales, and, usually from ten to twelve inches in thickness on old trees, it is occasionally two feet thick near their base;[3] or sometimes in arid regions the bark is paler colored and soft and spongy.[4] The winter-buds are ovate and acute, with thin scales rounded, entire, or occasionally slightly erose or denticulate on the margins, the terminal bud being often a quarter of an inch in length and nearly twice as large as the lateral buds. The branchlets are covered for three or four years with fine pubescence, and during their first season are pale orange-color and lustrous; turning rather bright reddish brown in the autumn, they gradually grow dark gray-brown after their second summer. The leaves are straight or rarely slightly incurved, rounded and obtuse at the apex, or on leading shoots and rarely on lower sterile branches acute, with short slender callous tips, from three quarters of an inch to an inch and a quarter long, from one sixteenth to one twelfth of an inch wide, light yellow when they first emerge from the bud, and dark yellow-green or rarely light or dark bluish green at maturity,[1] and are usually persistent until their eighth year, when they begin to fall gradually and irregularly. The staminate flowers are from three quarters of an inch to an inch long, with orange-red anthers; and the pistillate flowers are about three quarters of an inch in length and nearly half an inch in thickness, their slender elongated bracts being deeply tinged with red, which is darkest on the midribs. The cones, which hang on stout stems often half an inch in length, and mostly fall as soon as their seeds have escaped in the autumn, are from two to four inches and a half in length and from an inch to an inch and a quarter in thickness, with scales which are thin, slightly concave, rounded and occasionally somewhat elongated at the apex, thin and more or less erose on the margins, and usually rather longer than they are broad; at midsummer, when the cones are fully grown, they are slightly puberulous, dark apple-green below, purplish toward the apex, and bright red on the closely appressed margins; and the pale green bracts, which are now slightly reflexed above the middle and from one fifth to one quarter of an inch wide, often protrude half an inch beyond their scales and begin gradually to turn brown. The seeds are a quarter of an inch long, nearly an eighth of an inch wide, light reddish brown and lustrous above, pale and marked below with large irregular white spots, and almost as long as their dark brown wings, which are broadest just below the middle, oblique above, and rounded at the apex.

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[1] I have not been able to obtain any reliable information concerning the maximum height of the Douglas Spruce. Lumbermen on Puget Sound habitually speak of trees from three hundred to three hundred and fifty feet tall, but their statements, unsupported by actual measurements, must be accepted cautiously. It is not impossible, however, that this tree may grow to even a greater height than three hundred and fifty feet, as large specimens in some of the sheltered valleys at the base of the Olympic Mountains of northwestern Washington tower far above the surrounding forest, which undoubtedly has an average height of nearly three hundred feet.

In this region and on the western slopes of Mt. Rainier in Washington, trunks from ten to eleven feet in diameter five feet above the surface of the ground and free of branches for two hundred or two hundred and fifty feet are not rare, two or three such trees sometimes standing on an acre of ground. Individuals twelve feet in diameter may occasionally be seen, although they are very rare, and lumbermen and prospectors tell of trees with trunks sixteen feet in diameter. The trunks of *Picea Sitchensis*, *Thuya plicata*, and of *Taxodium mucronatum* of Mexico are larger at the ground than those of *Pseudotsuga mucronata*, but they taper rapidly and soon lose their great girth, while the trunk of the Douglas Spruce carries its size to an immense height with a hardly perceptible reduction of diameter, and no other tree of the continent, excepting the two Sequoias, equals it in massiveness of trunk or in productiveness of timber. (See *Garden and Forest*, x. 292, f. 38.)

[2] In 1883 I found at an elevation of six thousand feet above the level of the sea, at the head of the Cutbank River, on the eastern side of one of the northern passes over the continental divide in Montana, a Douglas Spruce only eighteen inches in height but covered with cones of full average size.

[3] The thickest specimen of the bark of *Pseudotsuga mucronata* which I have seen was in Seattle, Washington, and was twenty-six inches in thickness.

[4] Upon the soft spongy character of the bark of the Douglas Spruce on the San Francisco Peaks in northern Arizona and on some of the mountain ranges of northern New Mexico, Lemmon based his variety *suberosa* (*Erythea*, i. 48). On the San Francisco Peaks *Abies concolor* and *Abies lasiocarpa* have also soft spongy bark, which is probably the result of peculiar climatic conditions.

From the shores of Lake Tacla in the Rocky Mountains, a little to the north of the fifty-fifth degree of latitude and from the head of the Skeena River in the coast range in latitude 54° north,[2] *Pseudotsuga mucronata* spreads southward through all the Rocky Mountain system to the mountains of western Texas and to those of southern New Mexico and Arizona, along the Sierra Madre of Chihuahua[3] and the mountains of Nuevo Leon, where it forms dark groves in ravines and on northern slopes of the highest mountains,[4] to San Luis Potosí;[5] in the coast region it extends southward at some distance from the sea to latitude 51° north, and then spreads over Vancouver Island, over the coast valleys and plains of southern British Columbia, Washington, and Oregon, and over their mountains, ranging in British America eastward to the eastern foothills of the Rocky Mountains.[6] In California the Douglas Spruce extends southward in the coast mountains at least as far as Punta Gorda in Monterey County, near the lower end of the Santa Lucia Mountains,[7] over the cross ranges in the northern part of the state, and southward along the western slopes of the Sierra Nevada to the main fork of the San Joaquin River in latitude 37° 30′ north, where it ascends to elevations of seven thousand feet above the sea; but it is absent from all the arid mountains which rise in the great basin between the Sierra Nevada and the Wahsatch Ranges. In the dry interior region of the continent, where the Douglas Spruce grows only on rocky mountain slopes and benches, usually singly among other trees, and rarely forms an important part of continuous forests except in northern New Mexico and Arizona, it seldom attains a greater height than eighty feet; northward it is generally found at elevations of from four to six thousand feet above the sea-level; in Colorado it is scattered from the upper slopes of the foothills at elevations of about six thousand feet up to eleven thousand feet;[1] it is common on the high mountains of northern and central New Mexico,[2] and on the San Francisco Peaks of northern Arizona it forms a large part of the forest between elevations of eight thousand two hundred and nine thousand feet;[3] it is abundant on the Guadaloupe Mountains of western Texas, where in size and numbers it is surpassed only by *Pinus ponderosa*;[4] and on the mountain ranges of southern New Mexico and Arizona, where it is comparatively rare and usually of small size, it seldom ascends higher than six or seven thousand feet. It is most abundant and of its largest size not far above the level of the sea in southern British Columbia and in the region between the coast of Washington and Oregon and the western foothills of the Cascade Mountains, where enormous trunks crowded close together rise to a great height, forming, either alone or mixed with the Hemlock, vast almost impenetrable forests; these are surpassed in productiveness only by the Sequoia forests of California, and appear to reach their maximum development south of the Straits of Fuca on the lower northern slopes of the Olympic Mountains, where rains falls more constantly and copiously than on any other part of the United States with the exception of the Alaska coast. On the Cascade Mountains and the California coast ranges the Douglas Spruce is less abundant and rarely more than one hundred and fifty feet in height, but it frequently grows to a large size on the California Sierras, where it seldom ascends higher than five thousand five hundred feet above the sea and is most often scattered among other trees, but sometimes forms small groves, especially on the rough boulder-covered slopes of earthquake taluses which occasionally it almost exclusively covers.[5]

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[1] In Colorado and New Mexico the leaves of individual trees of *Pseudotsuga mucronata*, like those of many other conifers on the southern Rocky Mountains, are light or dark blue in color, especially early in their first season.

[2] In British Columbia, where in the dry interior southern portion *Pseudotsuga mucronata* is confined to the high ridges which separate the river-valleys, and at the north descends to the plateaus, it occurs with a few individuals on the Skeena River, but is absent from the Queen Charlotte Islands and the coast archipelago north of Vancouver Island, occurring here only on the shores of inlets at some distance from the sea. Southward from latitude 51° north, however, it is abundant in the coast region of the mainland and in all parts of Vancouver Island with the exception of the exposed western coast; and near the forty-ninth parallel it extends from the ocean to the eastern slopes of the Rocky Mountains, sometimes ascending to elevations of six thousand feet above the sea. It does not grow in the elevated and comparatively humid Cariboo region or on the higher portions of the Gold and Selkirk Ranges. The line which marks the northern limits of its distribution as now known is curiously irregular. It grows in the neighborhood of Fort George and northeastward as far as McLeod's Lake, but it has not been found on the Parsnip River; it extends half way up Lake Tacla, occurs on the shores of Babine Lake, and is common about Fraser and François Lakes. It ranges from the valley of the Fraser River to the coast mountains on the line of the Chilcotin and its tributaries, and occurs on the Narco and up the Blackwater to the mouth of the Iscultaesli, but is absent from the region northward from these streams to François Lake. The extension of its range to the northeast on the Rocky Mountains is still to be determined. (See G. M. Dawson, *Can. Nat.* n. ser. ix. 323. — Macoun, *Cat. Can. Pl.* 472.)

[3] "I saw heavy forests of Pseudotsuga on the cooler and more fertile slopes of the Sierra Madre of Chihuahua some two hundred miles south of our boundary." (C. G. Pringle *in litt.* See, also, C. G. Pringle, *Garden and Forest*, i. 441.)

[4] Watson, *Proc. Am. Acad.* xviii. 158. — C. G. Pringle, *l. c.* iii. 338.

[5] *Tsuga mucronata* was collected by Parry and Palmer near the city of San Luis Potosí in 1878.

[6] In June, 1897, Mr. John Macoun found *Pseudotsuga mucronata* on Jumping Pond Creek, near Calgary, Alberta, which is the most eastern station in British America from which I have seen specimens of this tree.

[7] *Pseudotsuga mucronata* is common on the Santa Lucia Mountains at elevations of from twenty-five hundred to about three thousand feet above the sea, but I have not been able to hear of it at any point farther south on the coast mountains. It is not improbable, nevertheless, that it may extend along them into San Luis Obispo County or even to the northern part of Santa Barbara County. On the Santa Inez Mountains in the southern part of the last named county the Pseudotsuga is of the southern species.

The wood of *Pseudotsuga mucronata* varies greatly in density and quality and in the thickness of the sapwood. It is light red or yellow, with nearly white sapwood, and is marked by conspicuous dark-colored very resinous bands of small summer cells which generally occupy at least half the layers of annual growth, and after the tree has been cut become hard and flinty, making the wood difficult to work. Two varieties of wood, red and yellow, the former coarser grained, darker colored, and less valuable than the latter, are distinguished by lumbermen, and appear to be largely due to the age of the tree, the wood of young trees being coarser grained and darker colored than that of old trees. The average specific gravity of the absolutely dry wood of twenty-one specimens cut in different parts of the country was 0.5157, a cubic foot weighing 32.14 pounds. The wood of *Pseudotsuga mucronata*, which furnishes most of the coarse lumber manufactured in southern British Columbia and in western Washington and Oregon,[6] is largely used for all kinds of construction, for fuel, and for railway-ties; it supplies most of the piles used on the Pacific coast of North America, and spars and masts of unequaled strength.[7] The bark is sometimes used in tanning leather.[8]

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[1] Brandegee, *Bot. Gazette*, iii. 33.

[2] Rusby, *Bull. Torrey Bot. Club*, ix. 79.

[3] Merriam, *North American Fauna*, No. 3, 121.

[4] Havard, *Proc. U. S. Nat. Mus.* viii. 503. — Coulter, *Contrib. U. S. Nat. Herb.* ii. 555 (*Man. Pl. W. Texas*).

[5] Muir, *The Mountains of California*, 168.

[6] In commerce the wood of *Pseudotsuga mucronata* is often called Oregon pine.

[7] Laslett, *Timber and Timber Trees*, ed. 2, 374.

[8] The following unpublished analysis of a specimen of the bark of *Pseudotsuga mucronata* from Forest Grove, Oregon, has been made by Professor Henry Trimble of the Philadelphia College of Pharmacy: —

Moisture	6.05	per cent.
Ash in absolutely dry material . .	1.22	"
Tannin in air dry material . . .	15.25	"
Tannin in absolutely dry material .	16.23	"

Pseudotsuga mucronata was discovered in 1791 on the shores of Nootka Sound by Archibald Menzies, the surgeon of Vancouver in his voyage of discovery; it was first described in the journal of Lewis and Clark.[1] Rediscovered by David Douglas in 1827, it was introduced by him into the gardens of Europe, where it has become one of the best known and most valuable coniferous trees for park plantations.[2] European sylviculturists have made numerous experiments with the Douglas Spruce in forest planting, but they are still divided in their opinions as to its value for this purpose.[3] Early attempts to introduce it into the eastern United States by means of plants obtained in England and raised from seeds gathered in Oregon or from trees which had grown in Europe were generally unsuccessful, the young plants soon succumbing to the heat and dryness of the eastern summers or to the cold of eastern winters. But in 1862 Dr. C. C. Parry found the Douglas Spruce on the outer ranges of the Rocky Mountains of Colorado, and the following year sent seeds to the Botanic Garden of Harvard College. The plants raised from these seeds have proved perfectly hardy and have grown rapidly and vigorously in the neighborhood of Boston, and now give promise of surpassing all other exotic conifers in permanent beauty and usefulness; and in recent years the Douglas Spruce, raised from seeds gathered at high altitudes in Colorado, has been planted in considerable numbers in the northern states.[4] Of the numerous abnormal forms of *Pseudotsuga mucronata* which may be occasionally seen in European gardens and which are peculiar in the marking of their leaves or in their habit, none has any great permanent value.[5] More beautiful are the plants from Colorado and from the mountains of Mexico with blue and glaucous foliage.[6]

One of the most widely distributed trees of North America, the Douglas Spruce possesses a constitution which enables it to flourish through thirty-two degrees of latitude, to support the fierce gales and the long winters of the north and the nearly perpetual sunshine of the Mexican Cordilleras, to thrive in the rain and fog which sweep almost continuously from the Pacific over its lofty heads, and on arid mountain slopes in the interior, where for months of every year rain never falls. It is one of the most important elements of the American forest. No other American tree of the first magnitude is so widely distributed or can now afford so much timber, and the rapidity of its growth

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COMBUSTION OF THE TANNIN.

Carbon	61.72 per cent.
Hydrogen	5.73 "
Oxygen	32.55 "
	100.00

The amount of tannin, 15.25 per cent., in air dry material is higher than is usually found in other tan-barks.

[1] *The History of the Expedition under Command of Lewis and Clark*, ed. Coues, iii. 831.

[2] A Douglas Spruce, raised from one of the seeds sent to England by David Douglas in 1827 and planted in 1830 where it now stands in the Pinetum at Dropmore, near Windsor, in 1893, was one hundred and twenty feet high, with a trunk four feet in diameter and long lower branches sweeping the ground. For sixty years, therefore, this tree has made an annual average upward growth of two feet and has added annually four fifths of an inch to the diameter of its trunk. Its upward growth has, indeed, really been greater, as part of the head was blown off several years ago in a winter storm. (See J. G. Jack, *Garden and Forest*, vi. 14. See, also, Fowler, *Gard. Chron.* 1872, 75; *Gard. Chron.* 1872, 1323, f. 299.) A Douglas Spruce in the Garden of Penrhyn Castle in Wales, supposed to have been planted fifty-seven years before, had in 1887 a trunk which girted thirteen feet eight and one half inches three feet above the surface of the ground, and another specimen on the same estate had a trunk eleven feet nine inches in circumference. (See Webster, *Gard. Chron.* ser. 3, i. 672, f. 130. See, also, Webster, *l. c.* n. ser. xxi. 59; *Trans. Scottish Arboricultural Soc.* xi. 56, 165.)

[3] See John Booth, *Die Douglas Fichte; Die Naturalisation Ausländischer Waldbäume in Deutschland*, 131; *Zeitsch. Forst-Jagd.* xxii. 32 (*Die Naturalisation der Douglasfichte*); *Gartenflora*, xl. 595. — J. Brown, *The Forester*, ed. 5, 353, f. 123. — Willkomm, *Forst. Fl.* ed. 2, 104, t. 19, f. 13, 18. — Mayr, *Wald. Nordam.* 290, t. 4, 6, 8, 9. — R. Hartig, *Forst.-nat. Zeit.* i. 415. — Schlich, *Gard. Chron.* ser. 3, iv. 531, 568, 598; *Man. Forestry*, ii. 316. — Köhler, *Gartenflora*, xli. 114. — Dunn, *Jour. R. Hort. Soc.* xiv. 80.

[4] See *Garden and Forest*, iv. 190.

[5] For an account of the garden varieties of Pseudotsuga cultivated in Europe, see Carrière, *Traité Conif.* ed. 2, 257. — Beissner, *Handb. Nadelh.* 418. — Sudworth, *Bull.* No. 14, *Div. Forestry U. S. Dept. Agric.* 47.

[6] The form of *Pseudotsuga mucronata* with glaucous leaves, which was introduced from Mexico into European gardens by Roezl about forty years ago, is said to be a distinct and handsome plant. This is the *Pseudotsuga glaucescens*, Bailly, *Rev. Hort.* 1895, 88, t., and probably the *Picea glaucescens*, Gordon, *Pinetum*, Suppl. 47 (1862), and the *Picea religiosa glaucescens*, Gordon, *Pinetum*, ed. 2, 213 (1870). It is also the *Abies religiosa glaucescens*, Carrière, *l. c.* 274.

and its power of reproduction under favorable conditions[1] make it the most valuable inhabitant of the great coniferous forest of the northwest, which it ennobles with its majestic port and splendid vigor.

EXPLANATION OF THE PLATE.

Plate DCVII. Pseudotsuga mucronata.

1. A flowering branch, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. A pistillate flower, enlarged.
6. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone from Marvin Lakes, Colorado, natural size.
9. A cone-scale, upper side, with its seeds and bract, natural size.
10. Bracts from the base of a cone, natural size.
11. A seed, enlarged.
12. Vertical section of a seed, enlarged.
13. An embryo, enlarged.
14. Cross section of a leaf magnified fifteen diameters.
15. Winter-buds, natural size.
16. A seedling plant, natural size.

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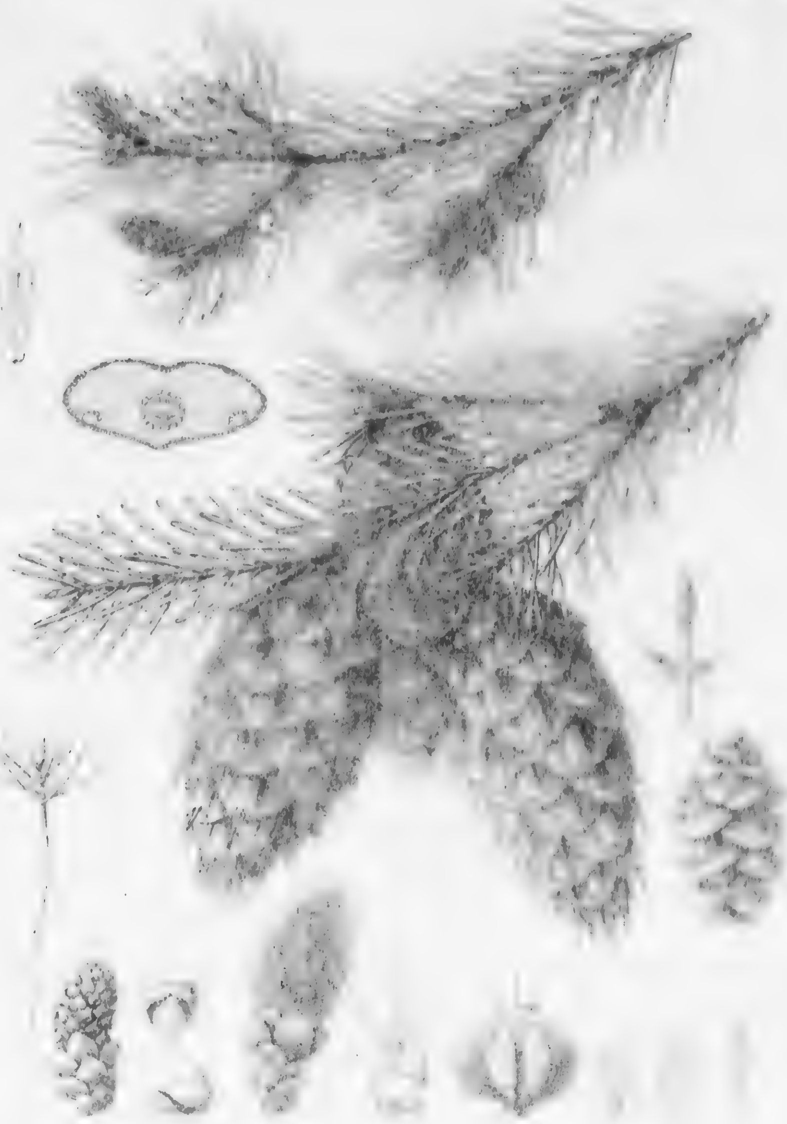
[1] In the coast region from southern British Columbia nearly to the northern borders of California seedling plants of *Pseudotsuga mucronata* soon cover the ground from which the forest has been cleared by fire, and, standing almost as close together as blades of grass, grow on good soil with astonishing rapidity, forming tall slender poles destitute of branches and foliage except at the very top. An average upward growth of five or six feet is not unusual on such trees, and leading shoots of *Pseudotsuga mucronata* ten feet long may be seen near the shores of Puget Sound. These young trees also increase their trunk diameter rapidly. A stem examined by General Henry L. Abbot on the Soldue River in northwestern Washington in 1896 had attained a diameter of six inches in ten years and of twelve inches in twenty-three years, and had increased to eighteen inches by its forty-fourth year. In the same region a tree only one hundred and forty-two years old had a trunk three feet four inches in diameter at three feet above the surface of the ground. This, however, is an exceptionally favorable region for the rapid growth of trees on account of the rich soil and the excessive rainfall. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, procured in the neighborhood of Portland, Oregon, is twenty-nine inches in diameter inside the bark and three hundred and thirty-six years old, the sapwood, which is only an inch and three eighths in thickness, showing sixty-six layers of annual growth. In the dry interior part of the continent the Douglas Spruce increases much more slowly and is by no means a fast-growing tree.



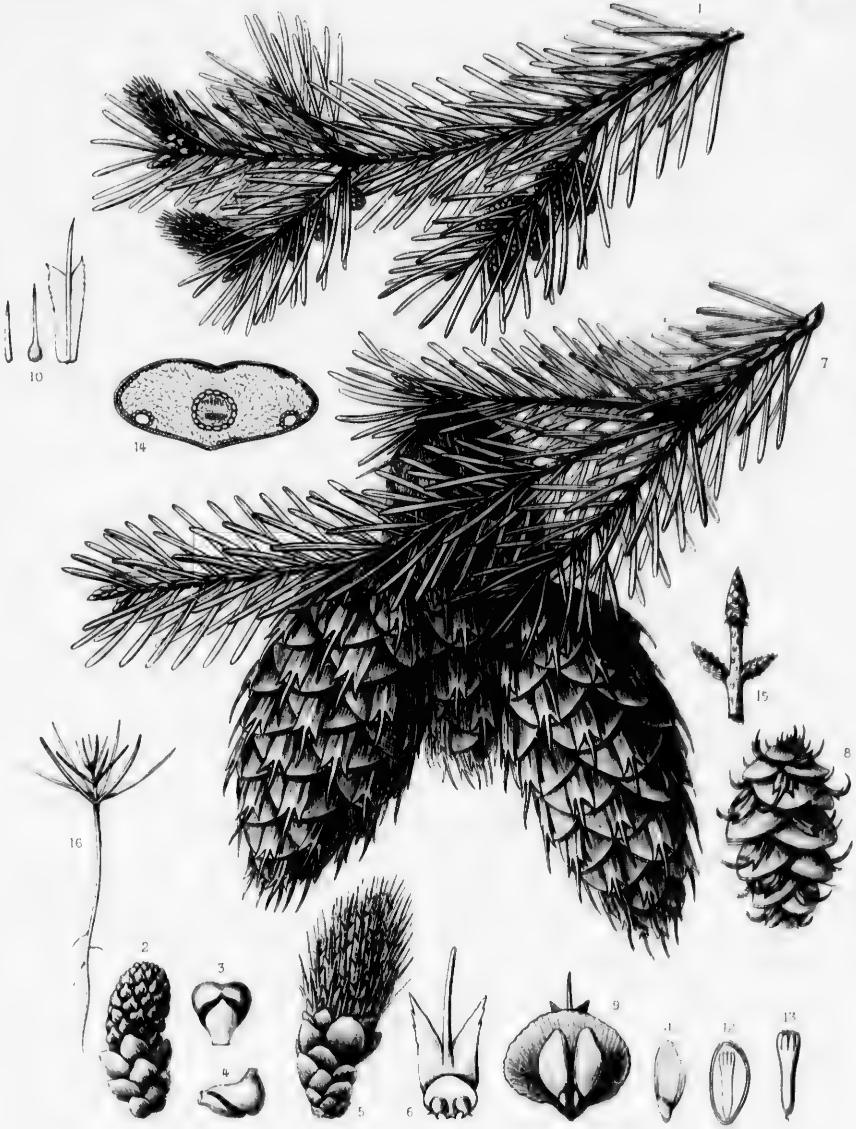
[illegible] of reproduction under favorable conditions make it the most valuable inhabitant of the [illegible] forest of the northwest, which it ennobles with its majestic port and splendid vigor.

[illegible] southern British Columbia nearly to [illegible] of California seedling plants of *Pseudotsuga* [illegible] the ground from which the forest has been [illegible], standing almost as close together as blades of grass, grow on good soil with astonishing rapidity, forming tall [illegible] poles destitute of branches and foliage except at the very top. An average upward growth of five or six feet is not unusual in such trees, and leading shoots of *Pseudotsuga* [illegible] ten feet long may be seen near the shores of Puget Sound. [illegible] also increase their trunk diameter rapidly [illegible] General Henry L. Abbot on the Sabine [illegible] region in 1880 had attained a diameter [illegible] and [illegible] twelve inches [illegible] three years [illegible] eighteen inches by its forty-fourth year. In the same region a tree only one hundred and forty-two years old had a trunk three feet four inches in diameter at three feet above the surface of the ground. This, however, is an exceptionally favorable region for the rapid growth of trees on account of the rich soil and the excessive rainfall. The log specimen in the Jesup Collection of North American Woods at the American Museum of Natural History [illegible], procured in the neighborhood of Portland, Oregon, [illegible] in diameter inside the bark and three hundred [illegible] years old, the sapwood, which is only an inch and [illegible] eighths in thickness, showing sixty-six layers of annual growth. [illegible] dry interior part of the continent the Douglas Spruce [illegible] slowly and is by no means a fast-growing tree.

PLATE DCVII. PSEUDOTSUGA [illegible]

1. A flowering branch, natural size.
2. [illegible] flower, enlarged.
3. A [illegible]
4. [illegible] anther, side view, [illegible]
5. A pistillate flower, enlarged.
6. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone from Marvine Lakes, Colorado, natural size.
9. A cone-scale, upper side, with its seeds and bract, natural size.
10. Bracts from the base of [illegible]
11. A seed, enlarged.

[illegible], vol. [illegible]



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Rapine sc.

PSEUDOTSUGA MUCRONATA, Sudw.

A. Riocreux direx.

Imp. J. Taneur Paris.

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PSEUDOTSUGA MACROCARPA.

Hemlock.

Leaves acuminate at the apex, bluish gray. Cones large, their bracts slightly exserted.

Pseudotsuga macrocarpa, Mayr, *Wald. Nordam.* 278 (1890). — Lemmon, *Rep. California State Board Forestry*, iii. 134 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 57; *Bull. Sierra Club*, ii. 162 (*Conifers of the Pacific Slope*). — Sudworth, *Rep. U. S. Dept. Agric.* 1892, 330. — Merriam, *North American Fauna*, No. 7, 340 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 223 (*Bot. Death Valley Exped.*). — Sargent, *Garden and Forest*, x. 24, f. 5.

Abies Douglasii, var. **macrocarpa**, Torrey, *Ives' Rep.* pt. iv. 28 (1861).

Abies macrocarpa, Vasey, *Gardener's Monthly*, xviii. 21 (1876).

Tsuga macrocarpa, Lemmon, *Pacific Rural Press*, xvii. No. 5, 75 (February 1, 1879).

Pseudotsuga Douglasii, var. **macrocarpa**, Engelmann, *Brewer & Watson Bot. Cal.* ii. 120 (1880). — Sargent, *Forest Trees N. Am.* 10*th Census U. S.* ix. 210. — Beissner, *Handb. Nadelh.* 417. — Koehne, *Deutsche Dendr.* 13.

A tree, usually from forty to fifty and rarely eighty feet in height, with a trunk three or four feet in diameter, which is generally naked at the base for about one quarter of its length, but sometimes is clothed to the ground with branches. These are remarkably remote, elongated and pendulous below, with short stout pendent or often erect lateral branchlets, and, short and ascending above, forming an open broad-based symmetrical pyramidal head. The bark is from three to six inches in thickness, dark reddish brown, and deeply divided into great broad rounded ridges which are covered with thick closely appressed scales. The winter-buds are ovate, acute, usually not more than an eighth of an inch in length, often nearly as broad as they are long, with dark chestnut-brown lustrous scales which are thin and scarious on the margins. The branchlets are slender, dark reddish brown during their first season, and covered with short scanty pubescence, which mostly disappears during their second year, when they are dark or light orange-brown and begin to grow lighter colored, becoming pale grayish brown at the end of four or five years. The leaves are acute or acuminate, terminating in slender rigid callous tips, apparently two-ranked by the conspicuous twisting at their base, incurved above the middle, from three quarters of an inch to an inch and one quarter in length, about one sixteenth of an inch wide, and dark bluish gray. The pistillate flowers are from three quarters of an inch to an inch in length, with pale yellow anthers, and are inclosed for half their length in the conspicuous involucres of the lustrous bud-scales. The staminate flowers are about an inch long and half an inch thick, with pale green bracts tinged with red. The cones, which are produced often in great numbers on the upper branches and occasionally also on those down to the middle of the tree, are short-stalked and from four to six and a half inches in length and about two inches in thickness; their scales, which near the middle of the cone are from an inch and a half to two inches across, are stiff, thick, concave, rather broader than they are long, rounded above, abruptly wedge-shaped at the base, puberulous and striate on the outer surface, and frequently nearly as long as their bracts, which are comparatively short and narrow, with broad midribs produced into short flattened flexible tips; opening and loosing their seeds early in the autumn, the cones mostly remain on the branches for at least a year longer. The seeds are full and rounded on both sides, rugose, dark chestnut-brown or nearly black and lustrous above, pale reddish brown below, with a thick hard brittle outer coat from which the thin membranaceous nearly white lining is easily separable; they are half an inch long and three eighths of an inch wide, with wings which are broadest near the middle, about half an inch long, nearly a quarter of an inch wide, and obliquely rounded at the apex; the cotyledons being from nine to twelve in number.[1]

Pseudotsuga macrocarpa is a characteristic feature of the scanty forests which cover the lower western and southern slopes of the arid mountains of southern California, where it grows above the banks of streams and on the steep slopes of narrow ravines usually between elevations of from three thousand to five thousand feet above the sea, and occasionally on high ridges, frequently forming open groves of considerable extent or mingling with *Quercus chrysolepis*, *Quercus Wislizeni*, *Pinus Coulteri*, *Pinus attenuata*, and *Pinus ponderosa*, var. *Jeffreyi*. The westerly station where *Pseudotsuga macrocarpa* has been observed is on the Santa Inez Mountains in Santa Barbara County.[2] Farther to the eastward it is common on the San Emigdio Mountains and on the Sierra Pelona, the San Gabriel, the Sierra Madre, the San Bernardino, the San Jacinto, and the Cuyamaca Mountains, which form a nearly continuous range extending in the arc of a circle from the neighborhood of Santa Barbara on the coast to the southern borders of the state.

The wood of *Pseudotsuga macrocarpa* is heavy, hard, strong, close-grained, and durable. It is dark red, with broad bands of small summer cells, numerous obscure medullary rays, and pale nearly white sapwood. The specific gravity of the absolutely dry wood is 0.4563, a cubic foot weighing 28.44 pounds. It is occasionally manufactured into lumber, and it is largely used for fuel.

Pseudotsuga macrocarpa was discovered in 1858 by the expedition under command of Lieutenant J. C. Ives, sent by the government of the United States to explore the Colorado River of the West. Although its seeds have been sent to Europe by collectors, *Pseudotsuga macrocarpa* does not appear to have been successfully cultivated, although it might be expected to thrive in regions where the summers are hot and dry and the winters mild with scanty rainfall.[3]

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[1] *Pseudotsuga macrocarpa* can be distinguished from the other American species by its comparatively longer and more remotely placed branches, by its sharply pointed peculiarly colored blue-gray leaves, by its shorter and stouter winter-buds, and larger cones, with thicker more concave cone-scales, comparatively shorter bracts with short broad tips, and by its larger and fuller seeds, which have a thicker and harder coat and are much darker on the upper face. Intermediate forms are not known to exist between the two species, which occupy different regions, *Pseudotsuga mucronata*, having failed to reach the mountains of southwestern California, which are the only home of *Pseudotsuga macrocarpa* either along the California coast ranges, the Sierra Nevada, or from the Rocky Mountains across the Colorado Desert.

[2] A single tree of *Pseudotsuga macrocarpa* was found in June, 1898, by Dr. F. Franceschi in Mission Cañon, above the Seven Falls, at an elevation of about fifteen hundred feet above the sea on the Santa Inez Mountains, about six miles from Santa Barbara.

[3] Like other trees of extremely arid regions, *Pseudotsuga macrocarpa* probably always grows slowly. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is twenty-eight and three quarters inches in diameter inside the bark and three hundred and thirty-six years old, with one and three eighths inches of sapwood which shows sixty-six layers of annual growth.

EXPLANATION OF THE PLATE.

Plate DCVIII. Pseudotsuga macrocarpa.

1. A flowering branch, natural size.
2. A staminate flower, enlarged.
3. An anther, side view, enlarged.
4. A pistillate flower, enlarged.
5. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
6. A fruiting branch, natural size.
7. A cone-scale, upper side, with its seeds, natural size.
8. A seed with its wing, natural size.
9. Cross section of a leaf, magnified fifteen diameters.
10. Winter-buds, natural size.

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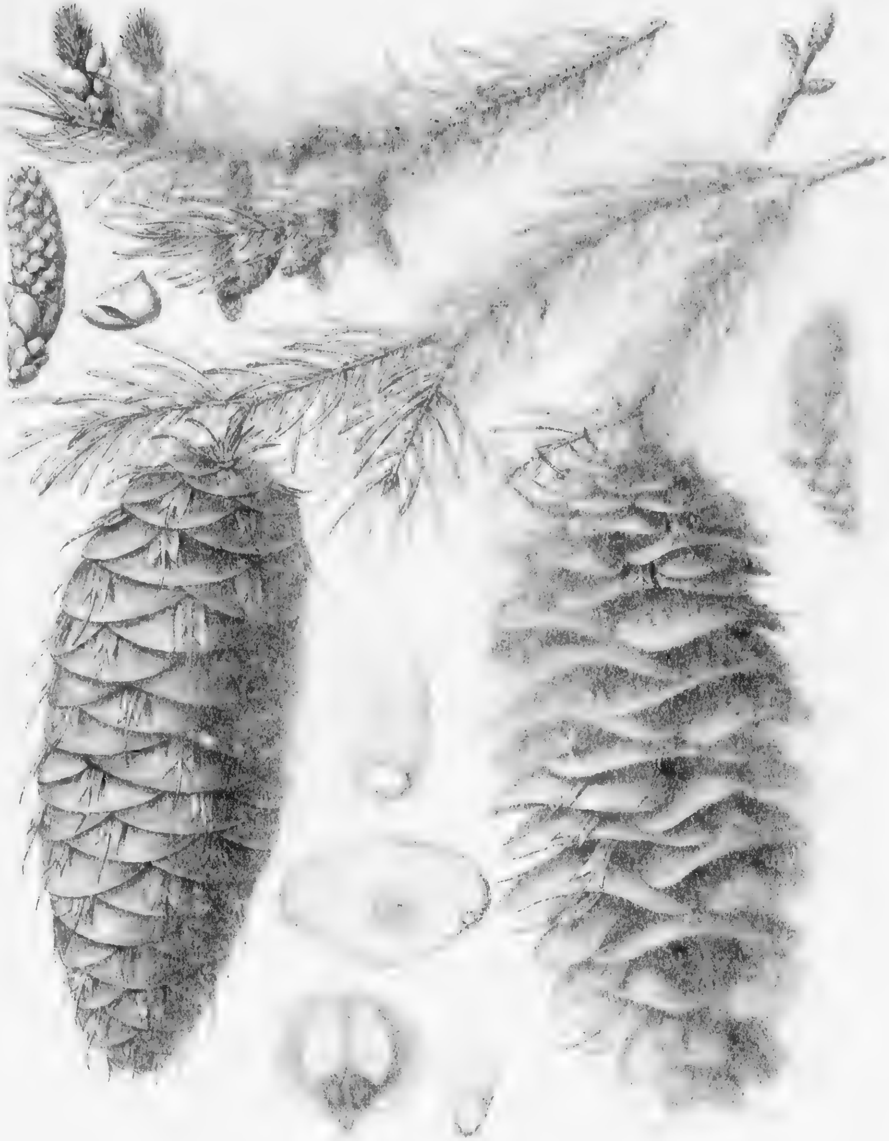

[illegible] inch wide, and [illegible] at the apex, the cotyledons being [illegible] nine [illegible].

[illegible] *macrocarpa* is a characteristic feature of the scanty forests which cover the lower [illegible] slopes of the arid mountains of southern California, where it grows above the [illegible], and on the steep slopes of narrow ravines usually between elevations of [illegible] thousand to five thousand feet above the sea, and occasionally on high ridges, frequently forming [illegible] groves of considerable extent or mingling with *Quercus chrysolepis*, *Quercus Wislizeni*, *Pinus Coulteri*, *Pinus [illegible]*, and *Pinus ponderosa* [illegible]. The westerly station where *Pseudotsuga macrocarpa* has been observed is on the [illegible] Mountains in Santa Barbara County.[1] Farther to the eastward it is common on the [illegible] Mountains and on the Sierra Pelona, the San Gabriel, the Sierra Madre, the [illegible] Jacinto, and the Cuyamaca Mountains which form [illegible] circle from the neighborhood of San [illegible] [illegible].

The [illegible] close-grained, and durable. It is [illegible] medullary rays, and pale nearly [illegible] .4563, a cubic foot weighing [illegible] used for fuel.

[illegible] command of Lieutenant [illegible] River of the West [illegible] in Europe to collectors [illegible] does not appear [illegible] cultivated, although it might be expected to [illegible] regions where the [illegible] dry and the winters [illegible] with severe cold.

[illegible] may be distinguished from the other [illegible] larger and more [illegible] [illegible] colored [illegible] [illegible] and longer [illegible] [illegible] Rocky Mountains [illegible].

[1] A single tree of *Pseudotsuga macrocarpa* was found in June 1898, by Dr. [illegible] Canon, above the [illegible] Falls, at an elevation of about [illegible] hundred feet above the sea on the Santa Ynez Mountains about six miles from Santa Barbara.

[illegible] trees of extremely [illegible], *Pseudotsuga* [illegible] [illegible] the American [illegible] [illegible] and three hundred and [illegible].

EXPLANATION OF THE PLATE.

[illegible] PSEUDOTSUGA MACROCARPA.

1. A flowering branch [illegible].
2. [illegible].
3. [illegible].
4. [illegible].
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9. [illegible] fifteen diameters.
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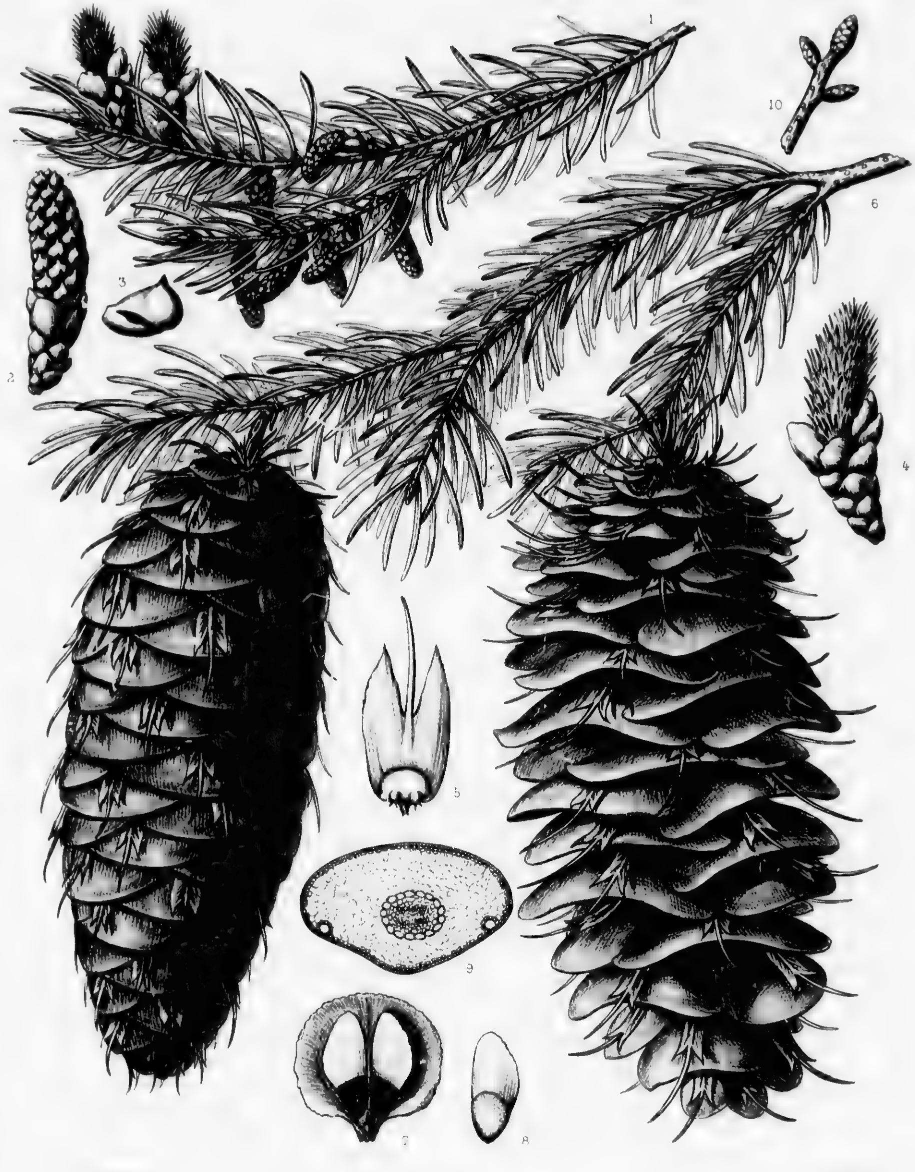

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ABIES.

Flowers solitary, naked, monœcious, axillary; stamens indefinite, anther-cells 2, surmounted by short knobs; scales of the pistillate flowers spirally disposed, ovules 2 under each scale. Fruit an erect strobile maturing in one season, its scales longer or shorter than their bracts, deciduous from the central axis; seeds furnished with resin vescicles. Leaves subdistichous, persistent.

Abies, Linnæus, *Gen.* 294 (in part) (1737). — Adanson, *Fam. Pl.* ii. 480 (in part). — A. L. de Jussieu, *Gen.* 414 (in part). — Link, *Abhand. Akad. Berl.* 1827, 181; *Linnæa*, xv. 525. — Engelmann, *Trans. St. Louis Acad.* ii. 211; iii. 593. — Bentham & Hooker, *Gen.* iii. 441. — Eichler, *Engler & Prantl Pflanzenfam.* ii. pt. i. 81. — Masters, *Jour. Linn. Soc.* xxx. 34.

Pinus, Linnæus, *Gen.* ed. 5, 434 (in part) (1754). — Endlicher, *Gen.* 260 (in part). — D. Don, *Lambert Pinus*, iii. (sect. *Peuce*). — Meissner, *Gen.* 352 (in part). — Baillon, *Hist. Pl.* xii. 44 (in part).

Picea, Loudon, *Arb. Brit.* iv. 2329 (not Link) (1838).

Tall pyramidal trees, with bark containing numerous prominent resin vesicles, and often thick and deeply furrowed in old age, pale usually brittle not durable wood, slender horizontal wide-spreading branches in regular remote generally four or five-branched whorls or rarely scattered, furnished with twice or thrice forked lateral branches forming flat-topped masses of foliage gradually narrowed from the base to the apex of the branch, the ultimate divisions comparatively stout, glabrous or pubescent, at right angles to the branch or pointing forward, wide-spreading roots, and slender elongated rootlets. Branch-buds usually three, or on the leading shoot four or five, the lateral in the axils of upper leaves, and much smaller than the terminal, generally thickly coated with resin, small, subglobose or oblong, acute or obtuse, or rarely large and acute, covered with numerous ovate acute closely imbricated accrescent rarely stomatiferous[1] scales increasing in size from below, the two lowest minute, opposite and lateral, the outer persistent on the base of the branch and in falling marking it with ring-like scars, the inner occasionally united and deciduous in one piece from the tip of the lengthening branchlet.[2] Leaves spirally disposed, incurved in the bud, at first densely crowded on the young branchlets, lanceolate or oblanceolate, entire and often thickened and revolute on the margins, sessile, marked on the lower surface on each side of the midrib with bands of several rows of stomata, persistent usually for from eight to ten years, leaving in falling nearly circular scars; hypoderm cells large, in continuous or interrupted bands under the epidermis on the upper surface, usually present also on the edges and keel of the leaf and in some species in its interior; resin ducts two, close to the epidermis of the lower surface, generally near the edge of the leaf, or in some species in the parenchyma and almost equidistant from the two surfaces; fibro-vascular bundles usually two or rarely one, occupying the interior of the leaf; on young plants and on lower sterile branches leaves flattened and mostly grooved on the upper surface, or in one species nearly tetragonal, rounded and usually emarginate at the apex, appearing two-ranked from a twist near their base or occasionally spreading from all sides of the branch, only rarely stomatiferous on the upper surface; usually on upper fertile branches and leading shoots crowded, more or less erect, often incurved or falcate, thick, convex on the upper side, or quadrangular in some species, obtuse or acute at the apex, and frequently stomatiferous on the upper surface; often crowded, arcuate, and forming a thick cover over the winter-buds on the ends of leading shoots and branches.[3] Flowers axillary, surrounded at the base by conspicuous involucres of their accrescent bud-scales, the inner often much enlarged and white and lustrous, appearing in early spring from buds formed the previous summer on branchlets of the year; the staminate on their lower side, very abundant on branches above the middle of the tree, the upper scales of their involucres falling early with the flowers, the lower often persistent for a year or two on the branches; the pistillate usually on the upper side only of the topmost branches, generally from one to four flowers appearing on a branch, or in some species scattered also over the upper half of the tree, their involucres more or less persistent under the cone. Staminate flowers pendulous, pedicellate, their slender pedicels often becoming much elongated before falling, oval or oblong-cylindrical; anthers short-stalked, subglobose, opening transversely, surmounted by the short knob-like projections of their connectives, yellow or scarlet; pollen-grains large, bilobed, furnished with two air-sacs. Pistillate flowers short-stalked, erect, globose, ovoid, or oblong, their scales spirally imbricated in many series, obovate, rounded above, cuneate below, much shorter than their acute or dilated and mucronate bracts; ovules two under each scale, collateral, inverted. Fruit an erect ovoid or oblong cylindrical strobile, maturing in one season, its scales thin, incurved at the broad rounded or rarely bluntly pointed apex, wedge-shaped, and gradually narrowed at the base into short or long stipes, closely imbricated, decreasing in size and sterile toward both ends of the cone, pale green, gray-brown, canary-yellow, or dark purple, puberulous or rarely glabrous on the exposed portions, longer or shorter than their membranaceous bracts, falling at maturity with their bracts and seeds from the stout tapering axis of the cone long persistent on the branch.[4] Seeds two under each scale, reversed, attached at the base, ovoid or oblong, acute at the base, compressed, furnished with large conspicuous resin vesicles, covered on the upper side and infolded below on the lower side by the base of their parchment-like oblong-obtuse wings formed from the inner coat of the scale, and abruptly enlarged at the somewhat obliquely rounded apex; testa thin, of two coats, the inner membranaceous, the outer thicker, coriaceous. Embryo axile in copious fleshy albumen; cotyledons from four to ten, stomatiferous on the upper surface.[5]

Abies is distributed in the New World from Labrador and the valley of the Athabasca River to the mountains of North Carolina, and from the mountains of Alaska to the highlands of Guatemala, and in the Old World from Siberia and the mountains of central Europe to southern Japan, the Himalayas, Asia Minor, and the mountains of northern Africa. Twenty-three species can now be distinguished;[6] in America two species inhabit the eastern part of the continent; seven occur on the mountains of the west, and one is found only in Mexico and Guatemala.[7] Four species are scattered through the mountain forests of the island of Hondo, and another forms large forests on the islands of Yezo and Saghalin.[8] *Abies Sibirica*[9] is widely distributed through northern continental Asia, and on the Himalayas *Abies Webbiana*[10] grows in great subalpine forests. *Abies Nordmanniana*[11] and *Abies Cilicica*[12] are important elements in the forest-covering of the Caucasus and the Cilician Taurus; *Abies Cephalonica*[13] is spread over the mountains of Cephalonia and Greece, and is replaced on the mountains of central and southern Europe by *Abies Picea*.[14] *Abies Pinsapo*[15] grows only on the mountain ranges of southern Spain, and *Abies Baborensis*[16] is confined to the mountain forests of northern Africa. Traces of Abies in the tertiary rocks of Grinnell Land show that it once inhabited the Arctic Circle, from which it was driven southward by the refrigeration of the northern hemisphere to the mountains of the south, which are now its principal home[17] and on which in Europe there were probably more species than at the present time.[18]

Abies produces soft perishable wood, sometimes manufactured into cheap lumber, and balsamic exudations employed in medicine and the arts.

Abies in North America does not suffer seriously from the attacks of insects[19] or fungal diseases.[20]

All the species are beautiful garden plants in youth, although when removed from their native mountain forests they usually become thin and ragged in old age, and several of the Fir-trees are common inhabitants of the parks of temperate countries, especially those native to western North America, the Japanese *Abies Momi*,[21] *Abies Veitchi*,[22] *Abies homolepis*,[23] and the species of Europe and Asia Minor.

Abies, the classical name probably of the Fir-tree, was used by Tournefort[24] as the name of the genus in which he united the Spruces, Firs, and Hemlocks, and was afterwards adopted by Linnæus, who, in his genus Abies, also united the Spruces and Hemlocks with the Silver Firs.

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[1] A. P. Anderson, *Bot. Gazette*, xxiv. 294, f.

[2] Henry, *Nov. Act. Acad. Cæs. Leop.* xix. 100, t. 14.

[3] Bailly, *Rev. Hort.* 1894, 275, f. 102 (*Du Rôle Protecteur du Feuillage chez les Conifères*).

[4] The color of the cones of Abies cannot be depended on as a means of determining the species. The cones of the European *Abies Picea* in the Black Forest, according to Engelmann, are of all variations of color between light green and dark purple (see *Trans. St. Louis Acad.* iii. 603), and on different trees of *Abies concolor* of western America the cones are light or dark green, purple, or bright canary-yellow. Nor can good specific characters be found in the shape of the cone-scales, as these vary in the same species, some cones having scales which are longer and others which are shorter than they are broad. More constant in shape are the bracts of the cone-scales, which, although they are very nearly alike on certain species, usually vary only slightly on different individuals of the same species.

[5] The species of Abies may be grouped in three sections: —

EUABIES (*Balsameæ* and *Grandes*, Engelmann, *Trans. St. Louis Acad.* iii. 596 [1873]). Leaves flat, grooved above, stomatiferous on the upper surface only on upper fertile branches.

BRACTEATES (Engelmann, *l. c.* in part). Leaves flat, slightly rounded and without stomata on the upper surface, alike on sterile and fertile branches.

NOBILES (Engelmann, *l. c.*). Leaves stomatiferous on both surfaces, crowded, incurved, tetragonal on fertile and in one species on sterile lower branches.

[6] In France a hybrid Abies has been raised by Monsieur H. L. de Vilmorin, who fertilized in 1867 a female flower of *Abies Pinsapo* with pollen of *Abies Cephalonica*. By this operation a single seed was obtained which produced a plant distinguished by its extreme vigor, resembling its pollen parent in habit, in the length, coloring, and subdistichous arrangement of the leaves, and in the shape of its cones, while in the shape and arrangement of its branches and in the thickness of its leaves it resembles *Abies Pinsapo*. (See Bailly, *l. c.* 1889, 115. — Beissner, *Handb. Nadelh.* 443.)

Abies insignis of French gardens is believed to be a hybrid obtained from seeds produced on a plant of *Abies Pinsapo* in Monsieur Renault's nursery at Bulgnéville and accidentally fertilized with the pollen of an *Abies Nordmanniana* growing near it. Another supposed hybrid, *Abies Nordmanniana speciosa*, was created by the French nurseryman Creux by fertilizing the pistillate flowers of *Abies Nordmanniana* with the pollen of *Abies Pinsapo*. (See Bailly, *l. c.* 1890, 230. — Beissner, *l. c.* 437, 438.)

[7] *Abies religiosa*, Lindley, *Penny Cycl.* i. 31 (1833). — Carrière, *Traité Conif.* 201. — Roezl, *Cat. Conif. Mex.* 9. — Engelmann, *l. c.* iii. 600. — Hemsley, *Bot. Biol. Am. Cent.* iii. 190. — Masters, *Gard. Chron.* n. ser. xxiii. 56, f. 13; ser. 3, ix. 304, f. 69, 70; *Jour. Linn. Soc.* xxii. 194, t. 6. — Beissner, *l. c.* 490.

Pinus religiosa, Humboldt, Bonpland & Kunth, *Nov. Gen. et Spec.* ii. 4 (1817). — Kunth, *Syn. Pl. Æquin.* i. 352. — Schlechtendal & Chamisso, *Linnæa*, v. 77. — Lambert, *Pinus*, ed. 2, ii. t. — Schlechtendal, *Linnæa*, xii. 486. — Antoine, *Conif.* 75, t. 28, f. 2. — Endlicher, *Syn. Conif.* 92. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 420. — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 676, t. 46, f. 2.

Pinus hirtella, Humboldt, Bonpland & Kunth, *l. c.* (1817). — Kunth, *l. c.* — Schlechtendal, *l. c.* 487. — Antoine, *l. c.* 80. — Endlicher, *l. c.* 93.

Abies hirtella, Lindley, *l. c.* (1833). — Carrière, *l. c.* 203. — Roezl, *l. c.*

Picea religiosa, Loudon, *Arb. Brit.* iv. 2349, f. 2257 (1838). — A. Murray, *Gard. Chron.* n. ser. v. 560, f. 100.

Picea hirtella, Loudon, *l. c.* (1838).

Abies religiosa, which grows in forests on the highlands of central Mexico up to elevations of nine thousand feet above the sea and extends to the mountains of Guatemala, is a large tree sometimes one hundred and fifty feet in height, with acute or rarely obtuse leaves, dark green and lustrous above and silvery white below, and oblong-oval purple cones, their bracts being acute or cuspidate and longer than the scales. Discovered by Humboldt and introduced into the gardens of Europe by Hartweg in 1838, *Abies religiosa* flourishes in sheltered positions in the extreme southern part of Great Britain, where it has produced its cones, and on the shores of the Italian lakes where no other Fir-tree excels it in lustre of foliage or in the beauty of its brightly colored cones. The specific name of the Mexican Fir was given to it in allusion to the use of its branches in Mexico for the decoration of churches.

[8] *Abies Sachalinensis*, Masters, *Gard. Chron.* n. ser. xii. 588, f. 97 (1879); *Jour. Linn. Soc.* xviii. 517 (*Conifers of Japan*). — Veitch, *Man. Conif.* 106. — Mayr, *Monog. Abiet. Jap.* 42, t. 3, f. 6.

Abies Veitchi, var. *Sachalinensis*, F. Schmidt, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, xii. 175, t. 4, f. 13–17 (*Fl. Sachalinensis*) (1868). — Beissner, *l. c.* 461, f. 127.

Abies Sachalinensis is scattered among the deciduous-leaved trees which clothe the low hills of central Yezo, and forms extensive forests in the extreme northern part of the island and in Saghalin. It is a tall slender pyramidal tree, with pale bark and long narrow dark green leaves, oblong-cylindrical pale brown cones three or four inches long, with exserted bracts, and white winter-buds, by which it can always be distinguished from the other Japanese Fir-trees. The wood is used for building and for packing-cases. A curious form of this tree has been noticed by Professor Miyabe in central Yezo with red bark, dark red wood, and red cone-bracts. (See Sargent, *Forest Fl. Jap.* 83.) *Abies Sachalinensis* is hardy in eastern Massachusetts, where it grows more rapidly than any other species of Fir-tree, but as it begins to open its buds early in the spring it is usually destroyed in western Europe by late frosts.

[9] *Abies Sibirica*, Ledebour, *Fl. Alt.* iv. 202 (1833); *Icon. Fl. Ross.* v. 28, t. 500. — Link, *Linnæa*, xv. 527. — Trautvetter, *Middendorff Reise*, i. pt. ii. 170 (*Pl. Jen.*). — Carrière, *l. c.* 225. — Trautvetter & Meyer, *Middendorff Reise*, ii. pt. i. 86 (*Fl. Ochot.*). — Maximowicz, *Mém. Sav. Étr. Acad. Sci. St. Pétersbourg*, ix. 260 (*Fl. Amur.*). — Regel, *Mém. Acad. Sci. St. Pétersbourg*, sér. 7, iv. No. 4, 136 (*Tent. Fl. Ussur.*). — Beketow, *Bull. Soc. Nat. Mosc.* xxxviii. pt. i. 162, t. 5. — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 95. — Masters, *Jour. Linn. Soc.* xviii. 519 (*Conifers of Japan*). — Herder, *Bot. Jahrb.* xiv. 160 (*Fl. Europ. Russlands*).

Pinus Picea, Pallas, *Fl. Ross.* i. 7 (in part) (not Du Roi) (1784).

Pinus Sibirica, Turczaninow, *Bull. Soc. Nat. Mosc.* xi. 101 (*Cat. Pl. Baical.*) (1838). — Antoine, *Conif.* 64, t. 26, f. 1. — Ledebour, *Fl. Ross.* iii. 669. — Christ, *Verhand. Nat. Gesell. Basel*, iii. 545 (*Uebersicht der Europäischen Abietineen*). — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 425. — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 685, t. 47, f. 12.

Picea Pichta, Loudon, *Arb. Brit.* iv. 2338 (1838). — Maximowicz, *Bull. Phys. Math. Acad. Sci. St. Pétersbourg*, xv. 436 (*Bäume und Sträucher des Amurlands*). — Gordon, *Pinetum*, 156.

Abies Pichta, Forbes, *Pinetum Woburn.* 113, t. 39 (1839).

Pinus Pichta, Endlicher, *Syn. Conif.* 108 (1847). — Turczaninow, *Fl. Baicalensi-Dahurica*, ii. pt. i. 138.

Abies Sibirica, var. *alba*, Carrière, *Traité Conif.* 225 (1855).

Abies Sibirica, which is the only Fir-tree of northern Europe and northwestern Asia, ranges from northern and eastern Russia to Kamtschatka and Mongolia, and on the Altai Mountains is said to form great pure forests at elevations of about four thousand feet above the sea-level. It is a slender pyramidal tree, with pale bark, flat dark green leaves, and small cylindrical cones. In the northeastern United States *Abies Sibirica* is very hardy and grows rapidly, but usually loses its dense habit before it is twenty feet high, becoming ragged and unattractive in appearance. In western Europe it can scarcely be kept alive for many years, as the young shoots, which appear very early in the spring, are almost always injured by frost.

[10] *Abies Webbiana*, Lindley, *Penny Cycl.* i. 30 (1833). — Forbes, *l. c.* 117, t. 41. — Link, *Linnæa*, xv. 532. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 211 (excl. syn. *Abies bifida*). — Carrière, *l. c.* 223. — Boissier, *Fl. Orient.* v. 700. — Masters, *Gard. Chron.* n. ser. xxii. 467, f. 86; ser. 3, x. 306, f. 47. — Hooker f. *Gard. Chron.* n. ser. xxv. 788, f. 174, 175; *Fl. Brit. Ind.* v. 654. — Beissner, *Handb. Nadelh.* 479, f. 134.

Pinus Webbiana, Lambert, *Pinus*, ed. 2, i. 77, t. 44 (1828). — Antoine, *Conif.* 61, t. 24, f. 1. — Endlicher, *l. c.* 106. — Parlatore, *l. c.* — W. R. M'Nab, *l. c.* 691, t. 46, f. 18.

Pinus spectabilis, D. Don, *Prodr. Fl. Nepal.* 55 (1825). — Lambert, *l. c.* ii. 3, t. 2.

Picea Webbiana, Loudon, *l. c.* 2344, f. 2251-2253 (1838). — Gordon, *l. c.* 160.

Abies spectabilis, Spach, *Hist. Vég.* xi. 422 (1842). — K. Koch, *Dendr.* ii. pt. ii. 230.

Abies Webbiana is a tree sometimes one hundred and fifty feet in height, with a trunk from three to five and occasionally ten feet in diameter, leaves very dark green and lustrous on the upper surface and silvery white on the lower, and cylindrical or ovoid dark purple cones from four to six inches long. It is widely spread at high elevations over the Himalayas from Afghanistan to Bhotan, sometimes, in cold damp glades facing the north, forming, either alone or with the Birch, the highest forest belt; it is often associated, also, with the Spruce, the White Pine and the Hemlock, and with Birches, Maples, and Rhododendrons in great subalpine forests. The wood of the Himalayan Fir-tree is soft, pale, and not durable when exposed to the weather; it is used in mountain regions in the construction of houses and for shingles, and from Sikkim it is sent into Thibet. The bark is employed for the roofs of shepherds' huts and the twigs and leaves for fodder; a violet dye has been obtained from the cones (Gamble, *Man. Indian Timbers*, 406).

Brandis distinguishes two varieties of *Abies Webbiana* which other botanists have sometimes considered species. The first of them is α *Webbiana* (*Forest Fl. Brit. Ind.* 528 [1874]), which he describes as a small tree with shorter and less bifid leaves and usually shorter and thicker cones; this form grows on exposed rocky ridges at higher elevations than his

β *Pindrow*, *l. c.* (1874). — Beissner, *l. c.* 481.

Pinus Pindrow, D. Don, *Lambert Pinus*, iii. t. (1837). — Antoine, *l. c.* 62, t. 24, f. 2. — Endlicher, *l. c.* 106. — Parlatore, *l. c.* — W. R. M'Nab, *l. c.* 690, t. 47, f. 17.

Picea Pindrow, Loudon, *l. c.* 2346, f. 2254, 2255 (1838). — Gordon, *l. c.* 157.

Abies Pindrow, Spach, *l. c.* 423 (1842). — Royle, *Ill.* 350, t. 86. — Carrière, *l. c.* 221. — K. Koch, *l. c.* 229. — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 95. — Masters, *l. c.* 691, f. 154.

This is a larger tree found in sheltered places in good soil with longer leaves and usually cylindrical cones.

First cultivated in Europe in 1822, *Abies Webbiana*, although in a few favorable positions in Great Britain it has grown to a size sufficiently large to produce cones, has not on the whole proved particularly valuable as an ornamental tree in Europe; in the United States it is not hardy at the north, and southward is destroyed by heat and drought.

[11] *Abies Nordmanniana*, Spach, *l. c.* 418 (1842). — Carrière, *l. c.* 203. — Tchihatcheff, *Asie Mineure*, 494. — K. Koch, *l. c.* 218. — Boissier, *l. c.* — Masters, *l. c.* 142, f. 30. — Hooker, f. *Bot. Mag.* cxiv. t. 6992. — Beissner, *l. c.* 434, f. 120.

Pinus Nordmanniana, Steven, *Bull. Soc. Nat. Mosc.* xi. 45, t. 2 (1838); *Ann. Sci. Nat.* sér. 2, xi. 56; *Gard. Mag.* ser. 2, v. 225, f. 43. — Antoine, *l. c.* 74, t. 28. f. 1. — Endlicher, *l. c.* 97. — Ledebour, *Fl. Ross.* iii. 670. — K. Koch, *Linnæa*, xxii. 295. — W. R. M'Nab, *l. c.* 694, t. 48, f. 22.

Picea Nordmanniana, Loudon, *Encycl. Trees*, 1042, f. 1900 (1842). — Gordon, *l. c.* 150.

Picea Withmanniana, Carrière, *l. c.* 260 (1855). — Trautvetter, *Act. Hort. Petrop.* ix. 213 (*Incrementa Fl. Ross.*).

Pinus Abies, Parlatore, *Fl. Ital.* iv. 66 (in part) (not Du Roi) (1867); *De Candolle Prodr.* xvi. pt. ii. 420 (in part).

Abies Nordmanniana, which is the most eastern representative of a group of species of which *Abies Picea* of central Europe is the type, is a tree sometimes one hundred and fifty feet in height, with a trunk six feet in diameter, long crowded leaves dark green and lustrous on the upper surface and silvery white on the lower, and oblong-cylindrical or ellipsoidal dark orange-brown cones with conspicuously exserted bracts. It is an inhabitant of the mountains on the southern and southeastern shores of the Black Sea, including the western spurs of the Caucasus, and is common at elevations of two thousand feet above the sea-level. Introduced in 1848 into the gardens of western Europe, *Abies Nordmanniana* has proved the most vigorous of all the eastern Fir-trees, thriving in soils and situations where the others do not flourish, and one of the most useful exotic conifers for the decoration of the parks and gardens of temperate Europe. (See Hutchinson, *Trans. Agric. and Highland Soc.* ser. 4, x. 141. — Masters, *l. c.* 147, f. 30. — Webster, *Trans. Scottish Arboricultural Soc.* xi. 61. — Dunn, *Jour. R. Hort. Soc.* xiv. 86.) The Nordmann Fir is very hardy in the eastern United States as far north, at least, as eastern Massachusetts, but although dense in habit and very handsome while young, it is apt to become thin and shabby here at a comparatively early age.

[12] *Abies Cilicica*, Carrière, *l. c.* 229 (1855); *Fl. des Serres*, xi. 67, t. — Tchihatcheff, *l. c.* 494. — K. Koch, *Dendr.* ii. pt. ii. 221. — Bertrand, *l. c.* — Boissier, *l. c.* — Beissner, *l. c.* 448, f. 122.

Pinus Cilicica, Kotschy, *Oestr. Bot. Wochenbl.* iii. 409 (1853). — Parlatore, *De Candolle Prodr.* *l. c.* 422. — W. R. M'Nab, *l. c.* 694, t. 48, f. 23.

Abies selinusia, Carrière, *Fl. des Serres*, xi. 69 (1856).

Picea Cilicica, Gordon, *l. c.* Suppl. 50 (1862).

Abies Cilicica, which is described as a tree from forty-five to sixty feet in height, forms with the Cedar of Lebanon great forests on the Cilician Taurus at elevations of from four thousand five hundred up to six thousand feet above the sea-level, and grows also on the Anti-Taurus and the Lebanon. It bears slender flat leaves which are often an inch and a half long on sterile branches, and are dark green above and silvery white on the lower surface, and cones which are sometimes ten inches in length.

Abies Cilicica has proved one of the hardiest and handsomest of the exotic Fir-trees which have been introduced into the northern United States, where it grows rapidly and forms a broad-based compact mass of branches gradually narrowed above into a slender pyramidal head (Sargent, *Garden and Forest*, ii. 538. — Davis, *Garden and Forest*, vi. 468). Beginning to expand its buds very early in the spring, the Cilician Fir suffers in western Europe from spring frosts, which disfigure and often destroy it.

[13] *Abies Cephalonica*, Loudon, *Arb. Brit.* iv. 2325, *f.* 2235, 2236 (1838). — Forbes, *Pinetum Woburn.* 119, t. 42. — Link, *Linnæa*, xv. 530. — Carrière, *Traité Conif.* 211. — Boissier, *Fl. Orient.* v. 702. — Masters, *Gard. Chron.* n. ser. xxii. 592, f. 105. — Beissner, *Handb. Nadelh.* 438.

Picea Cephalonica, Loudon, *Gard. Mag.* ser. 2, v. 238, *f.* 49–56 (1839); *Encycl. Trees*, 1039, *f.* 1940–1946. — Gordon, *Pinetum*, 146.

Pinus Cephalonica, Endlicher, *Cat. Hort. Vindob.* i. 218 (1842); *Syn. Conif.* 98. — Antoine, *Conif.* 71, t. 27, f. 1. — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 695, t. 48, *f.* 24.

Pinus Abies, ε Cephalonica, Christ, *Verhand. Nat. Gesell. Basel*, iii. 544 (*Uebersicht der Europäischen Abietineen*) (1862). — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 422.

Abies Cephalonica robusta, Carrière, *Traité Conif.* ed. 2, 285 (1867). — Bailly, *Rev. Hort.* 1889, 309.

Abies Cephalonica grows only on Mt. Enos in the Island of Cephalonia where, at elevations of from four to five thousand feet above the sea-level, it covers a ridge twelve or fifteen miles in length. (See Napier, *The Colonies*, 338.) It is a tree sixty or seventy feet tall, with wide-spreading branches, broad sharp-pointed rigid dark green leaves standing out from the branches nearly at right angles, and gray-brown cylindrical pointed cones six or seven inches in length, with exserted or rarely included bracts (Bailly, *l. c.* 1888, 578).

Abies Cephalonica was first cultivated in 1824, when a few seeds were sent to England by General Sir Charles J. Napier, Governor of the Island of Cephalonia. In western Europe it is considered one of the most ornamental of the Old World Abies, and in the United States it has proved hardy as far north as eastern Massachusetts, healthy specimens thirty or forty feet in height existing in several American gardens.

The Fir-tree which is common and generally distributed over the mountains of Greece and Roumelia, often forming extensive forests at elevations of from fifteen hundred to four thousand feet above the sea-level, differs only from the Cephalonian Fir in the usually narrower and blunter leaves of some individuals, and is now generally considered a variety of that species. It is: —

Abies Cephalonica, var. *Apollinis*, Beissner, *l. c.* 440 (1891).

Abies Apollinis, Link, *l. c.* 528 (1841). — Carrière, *l. c.* 209. — Boissier, *l. c.*

Pinus Apollinis, Antoine, *l. c.* 73 (1840–1847).

Pinus Abies, β Apollinis, Endlicher, *Syn. Conif.* 96 (1847).

Abies Picea (B) *Apollinis*, Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 210 (1850). — Lawson, *Pinetum Brit.* ii. 167, t. 24.

Abies Reginæ Amaliæ, Heldreich, *Gartenflora*, ix. 313 (1860); x. 268.

Picea Apollinis, Gordon, *l. c.* Suppl. 44 (1862).

Pinus Abies, b Reginæ Amaliæ, Christ, *l. c.* (1862).

Pinus Abies, δ Apollinis, Christ, *l. c.* (1862).

Pinus Abies, δ Panachaica, Christ, *l. c.* 544 (1862).

Abies Cephalonica, α Parnassica, Henkel & Hochstetter, *Syn. Nadelh.* 161 (1865).

Abies Cephalonica, β Arcadica, Henkel & Hochstetter, *l. c.* 162 (1865).

Abies Apollinis, β Panachaica, Boissier, *l. c.* (1884).

Abies Apollinis, γ Reginæ Amaliæ, Boissier, *l. c.* (1884).

Abies Cephalonica, var. *Reginæ Amaliæ*, Beissner, *l. c.* 441 (1891).

This Greek Fir is interesting in its power of producing vigorous shoots from adventitious buds. This peculiarity was first noticed in 1859 in the Fir forests of the district of Tripolitza in central Arcadia, where from time immemorial the inhabitants of the neighboring villages had been in the habit of obtaining their small timber by cutting out the tops of the trees at different heights according to the size required. It was found that from the side branches of these mutilated trees a number of vertical stems often from eighteen to twenty feet in height and from twelve to fifteen inches in diameter had been produced, and that young trees cut at the ground had thrown up, like *Pinus rigida* in New Jersey, a coppice growth of vigorous shoots. (See Regel, *Gartenflora*, ix. 200, f. — Heldreich, *l. c.* x. 286, f.)

The Greek Fir has proved hardy in eastern Massachusetts, where it has already borne cones.

[14] *Abies Picea*, Lindley, *Penny Cycl.* i. 29 (not Miller) (1833). — K. Koch, *Dendr.* ii. pt. ii. 217. — Karsten, *Pharm.-med. Bot.* 325, f. 156.

Pinus Picea, Linnæus, *Spec.* 1001 (1753). — Lambert, *Pinus*, i. 46, t. 30. — Antoine, *l. c.* 68, t. 27, *f.* 2. — Ledebour, *Fl. Ross.* iii. 66.

Abies alba, Miller, *Dict.* ed. 8, No. 1 (1768).

Pinus Abies alba, Muenchhausen, *Hausv.* v. 222 (1770).

Pinus Abies, Du Roi, *Obs. Bot.* 39 (1771); *Harbk. Baumz.* ii. 95. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 28. — Visiani, *Fl. Dalm.* i. 200. — Endlicher, *l. c.* 95 (excl. syn. *Pinus Apollinis*). — Reichenbach, *Icon. Fl. German.* xi. 4, t. 533 (*Abies pectinata* on plate). — Parlatore, *Fl. Ital.* iv. 66 (excl. syn. *Abies Cephalonica, Abies Nordmanniana, Abies Apollinis, Abies Panachaica*, and *Abies Reginæ-Amaliæ*); *De Candolle Prodr. l. c.* 420 (in part).

Pinus pectinata, Lamarck, *Fl. Franç.* ii. 202 (1778). — W. R. M'Nab, *l. c.* 693, t. 48, f. 20, 21.

Abies minor, Gilibert, *Exercit. Phyt.* ii. 412 (1792).

Abies vulgaris, Poiret, *Lamarck Dict.* vi. 514 (1804). — Spach, *Hist. Vég.* xi. 415.

Abies pectinata, De Candolle, *Lamarck Fl. Franç.* ed. 3, iii. 276 (not Gilibert nor Poiret) (1805). — *Nouveau Duhamel*, v. 294, t. 82. — Richard, *Comm. Bot. Conif.* t. 2. — Link, *l. c.* 526. — Schouw, *Ann. Sci. Nat.* sér. 3, iii. 239 (*Conifères d'Italie*). — Hartig, *Forst. Culturpfl. Deutschl.* 26, t. 2. — Carrière, *l. c.* 205. — Fiscali, *Deutsch. Forstcult.-Pfl.* 17, t. 1, *f.* 1–7. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 16. — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 94. — Laguna, *Coniferas y Amentáceas Españolas*, 31; *Fl. Forestal Española*, pt. i. 24, t. 1. — Boissier, *l. c.* 701. — Colmeiro, *Enum. Pl. Hispano-Lusitana*, iv. 707. — Beissner, *l. c.* 428, f. 118, 119. — Herder, *Bot. Jahrb.* xiv. 160 (*Fl. Europ. Russlands*). — Hempel & Wilhelm, *Bäume und Sträucher*, i. 86, f. 44–49, t. 2.

Abies taxifolia, Desfontaines, *Hist. Arb.* ii. 579 (not Lambert) (1809).

Abies excelsa, Link, *Abhand. Akad. Berl.* 1827, 182 (1830).

Picea kukunaria, Wenderoth, *Pflanz. Bot. Gart. Marb.* 11 (1831).

Picea pectinata, Loudon, *Arb. Brit.* iv. 2329, f. 2237–2239 (1838).

Abies argentea, De Chambray, *Traité Arb. Rés. Conif.* 17, t. 1, f. 1, 2, t. 5, f. 1 (1845).

Pinus Abies, a pectinata, Christ, *Verhand. Nat. Gesell. Basel*, iii. 542 (*Uebersicht der Europäischen Abietineen*) (1862).

Abies Picea, which is the largest of the conifers of Europe, under exceptionally favorable conditions attains the height of two hundred feet, and forms a trunk eight feet in diameter. It is a tree with elongated horizontal lower branches, which, on the Jura and the Swiss Alps, occasionally develop lateral shoots that grow upward, and have the appearance of young perfectly developed trees (see Christ, *Garden and Forest*, ix. 273), and a pyramidal crown which in old age sometimes becomes round-headed. The leaves are flat, spreading in two ranks, dark green and lustrous on the upper surface and silvery white on the lower, and the slender cylindrical bluntly pointed cones are light green to deep purple and five or six inches long, with slightly exserted bracts.

Abies Picea is an inhabitant of the mountains of southern and central Europe, forming forests on the mountains of Catalonia and Aragon, and on the northern slopes of the eastern Pyrenees. In Corsica it is the principal tree in the belt above that of *Pinus Laricio* and below the forests of Beech. It grows also at high altitudes in Sicily, on the Apennines, the Jura and the Vosges, and in the Schwarzwald, in Saxony, Thuringia, the Tyrol, and Dalmatia.

The wood of *Abies Picea* is white, sometimes tinged with reddish brown, with sapwood which is hardly distinguishable from the heartwood; it is moderately elastic, soft, and easily worked, but not durable; it is used in the construction of buildings and boats, for masts, in cabinet-making and wood-carving, and for fuel and charcoal. The bark is employed for tanning leather. By puncturing the resin vesicles on the trunk Strasburg turpentine is obtained. Once highly esteemed in medicine, this substance was long ago dropped from the pharmacopœias of Europe, and is now almost forgotten. (See Belon, *De Arboribus Coniferis*, 28. — Dale, *Pharmacologia*, 395. — Stephenson & Churchill, *Med. Bot.* ii. t. 74. — Loudon, *l. c.* — Flückiger & Hanbury, *Pharmacographia*, 555. — Bentley & Trimen, *Med. Bot.* iv. 262, t. 262.) Strasburg turpentine is still occasionally used in the preparation of paints and varnish.

Young plants of *Abies Picea* are able to survive for a long time in the shade of other trees, and therefore this species has been found especially valuable by French and German sylviculturists for the natural reproduction of forests. In artificial planting, however, it usually proves more uncertain than the Spruce, although the great forest of this tree at Vallambrosa, overhanging the Arno and below the summits of the Apennines, has been perpetuated for centuries entirely by planting.

Abies Picea was introduced into England at the beginning of the seventeenth century, and has since been a favorite with English planters, who have produced many noble specimens. (See Strutt, *Sylva Britannica*, 31, t. 6. — Loudon, *l. c.* 2332.) *Abies Picea* was brought to the eastern United States early in the present century, but it is not very hardy even in the middle states, and is not usually kept alive here for more than a few years without difficulty.

A number of abnormal forms of *Abies Picea* are cultivated by European lovers of curious trees. The most distinct of these are the forms with erect and with pendulous branches, and one with short branches covered by short crowded leaves. (For a description of the garden forms of *Abies Picea*, see Carrière, *Traité Conif.* ed. 2, 280. — Veitch, *Man. Conif.* 104. — Beissner, *Handb. Nadelh.* 432.)

[15] *Abies Pinsapo*, Boissier, *Bibl. Univ. Genève*, xiii. 167 (1838); *Ann. Sci. Nat.* sér. 2, ix. 167; *Elench. Pl. Nov. Hisp.* 84; *Voy. Espagne*, ii. 584, t. 167–169. — Carrière, *Traité Conif.* 227. — Willkomm & Lange, *Prodr. Fl. Hispan.* i. 17. — K. Koch, *Dendr.* ii. pt. ii. 226. — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 95. — Laguna, *Coníferas y Amentáceas Españolas*, 31; *Fl. Forestal Española*, pt. i. 35, t. 2, 3. — Masters, *Gard. Chron.* n. ser. xxiv. 468, f. 99. — Colmeiro, *Enum. Pl. Hispano-Lusitana*, iv. 708. — Beissner, *l. c.* 444, f. 121.

Pinus Pinsapo, Antoine, *Conif.* 65, t. 26, f. 2 (1842–47). — Endlicher, *Syn. Conif.* 109. — Christ, *l. c.* 545. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 422 (excl. syn.) — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 697, t. 48, f. 26.

Picea Pinsapo, Loudon, *Encycl. Trees*, 1041 (1842). — Gordon, *Pinetum*, 159.

Abies Hispanica, De Chambray, *l. c.* 339 (1845).

Abies Pinsapo is a tree seventy or eighty feet in height, with a stout trunk usually clothed with branches to the ground, and distinguished by its stiff branchlets thickly set with short broad rigid sharply pointed erect bright green leaves spreading from all sides, and cylindrical gray-brown cones from four to six inches in length. It grows on the mountains of central and southern Spain, and forms great forests on the Sierra Nevada, at elevations of between four thousand and six thousand feet above the sea. It was introduced into gardens in 1839 by Boissier, who first distinguished the Pinsapo as a distinct species. In central and western Europe, where it is one of the most generally cultivated and handsomest of the Fir-trees, it has already grown to a large size, but in the eastern United States it never really flourishes, although it is possible to keep it alive for many years in favorable situations even as far north as eastern Massachusetts. (Sargent, *Garden and Forest*, vi. 458.)

[16] *Abies Baborensis*, Letourneux, *Cat. Arb. et Arbust. d'Algérie* (1888).

Abies Pinsapo, var. *Baborensis*, Cosson, *Bull. Soc. Bot. France*, viii. 607 (1861); *Annuaire Soc. Imp. d'Acclimatation*, 1863, 299; *Rev. Hort.* 1866, 144. — K. Koch, *l. c.* 227.

Abies Numidica, Carrière, *Rev. Hort.* 1866, 106, 203; *Traité Conif.* ed. 2, 305. — Veitch, *l. c.* 103. — Masters, *l. c.* ser. 3, iii. 140, f. 23. — Trabut, *Rev. Gen. Bot.* i. 405, t. 17, 18. — Beissner, *l. c.* 447. — Koehne, *Deutsche Dendr.* 16.

Pinus Pinsapo, Parlatore, *l. c.* (in part) (not Boissier) (1868).

Picea Numidica, Gordon, *Pinetum*, ed. 2, 220 (1875).

Pinus Baborensis, W. R. M'Nab, *l. c.* t. 48, f. 27 (1877).

The Algerian Fir, mingling with the Mt. Atlas Cedar, inhabits the slopes of Mt. Babor and Mt. Tababor, in the Province of Constantine, at elevations of from four to six thousand feet above the level of the sea. It is a tree sixty or seventy feet in height, with a slender trunk, spreading branches forming a compact pyramidal head, crowded dark green flat pointed or emarginate leaves, and cylindrical dull grayish brown cones from five to eight inches in length, their bracts being shorter or longer than their scales. Introduced into the gardens of central Europe in 1864, *Abies Baborensis* has proved hardy in France and England, and one of the most attractive members of the genus as a garden plant.

[17] The Cascade Mountains in Oregon must, perhaps, be regarded as the headquarters of the genus Abies, for on that part of the range which is south of the Columbia River, and which is not over one hundred and seventy miles long, are congregated six species,

Abies nobilis at the north, replaced southward by *Abies magnifica*, *Abies grandis* at the north replaced by *Abies concolor* at the south, and *Abies amabilis* and *Abies lasiocarpa*, extending down from the Columbia nearly to the southern end of the range.

[18] Saporta, *Origine Paléontologique des Arbres*, 77.

[19] Practically nothing is known of the insects which probably dwell upon the different species of Abies in the western part of America, and those which infest the eastern, *Abies balsamea* and *Abies Fraseri*, have been little studied. Many of the borers which attack Pinus and Picea also infest Abies, but no species peculiar to these trees has been reported. Nearly all the species of saw-flies, moths, and other insects which attack the foliage of Picea are also to be found on Abies, although a few species may be peculiar to Fir-trees. Various species of scale-insects are sometimes found on Abies, and a mite of the group Acrina commonly occurs on the young twigs, arresting the growth of the leaves and twisting and distorting them.

In England a woolly Aphis causes gouty swellings upon the leading and other shoots of *Abies nobilis*, *Abies amabilis*, and other Fir-trees, preventing the formation of leaders and eventually killing the trees. (See Masters, *Gard. Chron.* n. ser. xviii. 1091, f. 19, 20.) On the island of Mt. Desert, off the coast of Maine, *Abies balsamea* was attacked about a dozen years ago in a similar manner, and hundreds of trees were killed.

[20] The most striking fungus which infests *Abies balsamea*, the northeastern representative of the genus, is *Æcidium elatinum*, Albertini & Schweinitz, a rust which is common in cold and wet regions, especially in the mountainous districts from Newfoundland to Michigan, and southward to the mountains of North Carolina. Of all the so-called hexen-besen, or witches-brooms, sometimes called birds-nest distortions, those caused by this fungus are the largest that occur in the United States, being at times three feet high and three feet or more in circumference. On the affected branches is formed a node from which arise vertical dense tufts of fasciculated branches, so that the distortions which can be seen from a considerable distance look like small trees attached to the branches. In May and early June the branches are paler and more succulent, and the leaves are shorter and stouter than normal leaves, and show the yellow spots due to the spores of the fungus. Later in the season the spots disappear, the leaves shrivel, and the stems darken, although they last several years and produce successive crops of spores. This fungus has a very wide distribution, being common in Europe on *Abies Picea* and some other species, and extends to Siberia and Japan.

Another rust, *Peridermium balsameum*, Peck, is common on the under side of the leaves of *Abies balsamea*, especially in the mountainous regions of New England and New York. The cluster-cups of this species are small and short, the spores are nearly white, and no noticeable distortion is produced. The fungus, therefore, is not easily seen except by a practiced eye, although ultimately the affected leaves become pale-colored. Beside the rust fungi, several peculiar small species attack the leaves and stems of *Abies balsamea*, especially *Nectria balsamea*, Cooke & Peck, *Asterina nuda*, Peck, and *Meliola balsamicola*, Peck. *Fusisporium Berenice*, Berkeley & Curtis, the pycnidial condition of some Discomycete, forms slate-colored cups with a thin raised margin on the smaller branches, while the trunks are often covered by the orange-colored cups of *Dasyscypha Agassizii*, Saccardo, which seems to prefer this tree to any other, although it is found on other conifers.

The European *Abies Picea* is attacked by many species of fungi, including a number of small species recently described by Vuillemin (*Bull. Soc. Mycol.* xii. 33). The parasites of *Abies Fraseri* have not been well studied, but this tree is attacked by *Peziza crocea*, Schweinitz, and *Trichosphaeria parasitica*, R. Hartig.

Little is known of the fungal enemies of the Abies of western America.

[21] *Abies Momi*, Siebold, *Verhand. Bat. Genoot. Kunst. Wet.* xii. 26 (1830). — K. Koch, *Dendr.* ii. pt. ii. 227.

Abies firma, Siebold & Zuccarini, *Fl. Jap.* ii. 15, t. 107 (1842). — Carrière, *Traité Conif.* 212. — A. Murray, *The Pines and Firs of Japan*, 53 (excl. *Abies homolepis*), f. 96–115. — Miquel, *Ann. Mus. Bot. Lugd. Bat.* iii. 166 (*Prol. Fl. Jap.*). — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 95. — Franchet & Savatier, *Enum. Pl. Jap.* i. 467. — Masters, *Gard. Chron.* n. ser. xii. 198; *Jour. Linn. Soc.* xviii. 514 (*Conifers of Japan*). — Mayr, *Monog. Abiet. Jap.* 31, t. 1, f. 1. — Beissner, *Handb. Nadelh.* 450, f. 123.

Abies bifida, Siebold & Zuccarini, *l. c.* 18, t. 109 (1842). — Carrière, *l. c.* 214. — Bertrand, *l. c.*

Pinus firma, Antoine, *Conif.* 70, t. 27 bis. (1840–1847). — Endlicher, *Syn. Conif.* 99. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 424 (excl. syn.). — W. R. M'Nab, *Proc. R. Irish Acad.* ser. ii. 686, t. 47, f. 14 (excl. syn. *Pinus brachyphylla*).

Pinus bifida, Antoine, *l. c.* 79, t. 31, f. 2 (1840–47). — Endlicher, *l. c.* 101.

Picea firma, Gordon, *Pinetum*, 147 (1858). — A. Murray, *Proc. R. Hort. Soc.* ii. 351, f. 63–81.

Picea firma, var. B, A. Murray, *l. c.* 409 (1862).

Abies firma, var. *bifida*, Masters, *Gard. Chron.* n. ser. xii. 199 (1879); *Jour. Linn. Soc.* xviii. 514 (*Conifers of Japan*).

Pinus bifida, W. R. M'Nab, *l. c.* 688, t. 47, f. 15 (1877).

Abies umbellata, Mayr, *l. c.* 34, t. 1, f. 2 (1890).

Abies Momi, the largest of the Japanese Fir-trees and an inhabitant of the mountains of southern Hondo, where it is said to be abundant in the forests of deciduous-leaved trees, is the species best known to the Japanese, furnishing them with the Fir-wood of commerce and one of the chief ornaments of their parks. The Momi has usually proved disappointing in the United States and Europe, where, although it is hardy enough, it early becomes thin and ragged, but the Momis in the temple gardens of Tōkyō, often one hundred and twenty feet in height, with tall clean trunks from four to six feet in diameter and dense dark pyramidal crowns of rigid lustrous acute or bifid leaves, are certainly not surpassed in beauty by any other Fir-trees which men have planted. (See Sargent, *Forest Fl. Jap.* 82.)

[22] *Abies Veitchi*, Lindley, *Gard. Chron.* 1861, 23. — A. Murray, *The Pines and Firs of Japan*, 39, f. 69–79. — Gordon, *l. c.* Suppl 56. — Carrière, *Traité Conif.* ed. 2, 300. — K. Koch, *l. c.* 228. — Bertrand, *l. c.* — Franchet & Savatier, *l. c.* 468. — Masters, *Gard. Chron.* n. ser. xiii. 275, f. 50, 51; *Jour. Linn. Soc.* xviii. 515, t. 20 (*Conifers of Japan*). — Mayr, *l. c.* 38, t. 2, f. 4. — Beissner, *l. c.* 457, f. 125, 126.

Picea Veitchi, A. Murray, *Proc. R. Hort. Soc.* ii. 347, f. 52–62 (1862).

Pinus selenolepis, Parlatore, *l. c.* 427 (1868).

Pinus Veitchi, W. R. M'Nab, *l. c.* 686, t. 47, f. 13 (1877).

Abies Eichleri, Lauche, *Berlin Gartenzeit.* i. 63, f. (1882). — Hemsley, *Gard. Chron.* n. ser. xvii. 145. — Bolle, *Garden and Forest*, iii. 434.

Abies Veitchi, which is the prevailing tree in a forest belt between elevations of seven thousand and eight thousand feet above the sea on Mt. Fusi-san, appears to be of very local distribution in Japan, and is probably a northern tree finding its most southerly home only on the highest mountains of the empire, a little known

Fir-tree of the coast of Manchuria appearing to be identical with it. This is the

Abies Sibirica, var. *nephrolepis*, Trautvetter, *Maximowicz Mém. Sav. Étr. Acad. Sci. St. Pétersbourg* ix. 260 (*Prim. Fl. Amur.*) (1859).

Abies nephrolepis, Maximowicz, *Bull. Acad. Sci. St. Pétersbourg*, x. 486 (*Mél. Biol.* vi. 21) (1866). — Beissner, *Handb. Nadelh.* 457.

Abies Veitchi was sent from Japan in 1876 by Mr. Thomas Hogg to the Parsons Nurseries at Flushing, New York, and for many years was cultivated in the United States under the unpublished name of *Abies Japonica* (*Garden and Forest*, vi. 525). In our gardens it is a handsome hardy fast-growing tree, distinguished from *Abies homolepis*, to which it bears a superficial resemblance, by its shorter and more crowded leaves, its slenderer branchlets clothed with soft fine pubescence, and its smaller cones.

[23] *Abies homolepis*, Siebold & Zuccarini, *Fl. Jap.* ii. 17, t. 106 (1842). — Carrière, *Traité Conif.* 215. — Miquel, *Ann. Mus. Bot. Lugd. Bat.* iii. 166 (*Prol. Fl. Jap.*). — Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 95. — Masters, *Gard. Chron.* n. ser. xii. 823, f. 136; *Jour. Linn. Soc.* xviii. 518 (*Conifers of Japan*). — Mayr, *Monog. Abiet. Jap.* 35, t. 2, f. 3.

Pinus homolepis, Antoine, *Conif.* 78, t. 31, f. 1 (1840-47). — Endlicher, *Syn. Conif.* 101.

Picea firma, var. [illegible], A. Murray, *Proc. R. Hort. Soc.* ii. 409 (1862).

Abies firma, A. Murray, *Pines and Firs of Japan*, 53 (in part) (not Siebold & Zuccarini) (1863).

Abies brachyphylla, Maximowicz, *l. c.* 488 (1866) (*l. c.* 23). — Franchet & Savatier, *Enum. Pl. Jap.* i. 467. — Masters, *Gard. Chron.* n. ser. xii. 556, f. [illegible], 92; *Jour. Linn. Soc.* xviii. 515, f. 14, 15 (*Conifers of Japan*). — Veitch, *Man. Conif.* 88. — Hooker f. *Bot. Mag.* cxvi. t. 7114.

Pinus brachyphylla, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 424 (1868).

Pinus Tschonoskiana, Parlatore, *l. c.* 431 (1868).

Picea brachyphylla, Gordon, *Pinetum*, ed. 2, 201 (1875).

Pinus Harryana, W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 680, t. 47, f. 16 (1877).

Abies homolepis is the common Fir-tree of the Nikkō and other mountain ranges of central Japan, on which, at elevations of between four thousand and five thousand feet above the sea, it is scattered either singly or in small groves through the Oak and Birch forests that extend up to the great Hemlock belt which clothes the upper slopes of these mountains. It is a tree rarely more than eighty or ninety feet in height, with a massive trunk covered with pale bark, long distichously spreading leaves dark green on the upper surface and silvery white on the lower, and cylindrical purple cones usually about four inches in length. From other Japanese Fir-trees it may be distinguished in old age by the broad round-topped head formed by the upper branches, which grow more strongly near the top of the tree than those below them. The wood is occasionally used in the construction of huts in alpine villages.

Abies homolepis, which has been an inhabitant of the gardens of Europe and of the eastern United States for thirty years, grows vigorously in cultivation, and is very hardy in eastern Massachusetts, where it has already produced its cones, and in its young state is one of the handsomest and most satisfactory of the exotic conifers, although on the oldest plants the middle branches have already overgrown and overshadowed those below them.

[24] *Inst.* 585, t. 353, 354.

CONSPECTUS OF THE NORTH AMERICAN SPECIES.

Euabies. Leaves flat, grooved above, stomatiferous on the lower and sometimes on the upper surface, rounded and often notched, or on fertile branches frequently acute at the apex.

Resin ducts of the leaves within the parenchyma remote from the epidermis.

Bracts longer or shorter than the cone-scales.

Bracts of the cone-scales oblong, rounded and short-pointed at the broad denticulate apex, much longer than their scales, reflexed; leaves dark green and lustrous above, pale below, obtusely short-pointed and occasionally emarginate . . . . 1. A. FRASERI.

Bracts of the cone-scales oblong, emarginate and short-pointed at the broad serrulate apex, shorter or rarely slightly longer than their scales; leaves dark green and lustrous above, pale below, rounded or obtusely short-pointed and occasionally emarginate, and on fertile branches acute or acuminate . . . . 2. A. BALSAMEA.

Bracts much shorter than the cone-scales.

Bracts of the cone-scales oblong-obovate, laciniate, rounded, emarginate, and long-pointed at the apex; leaves blue-green and glaucous, stomatiferous above the middle on the upper surface, obtusely pointed and occasionally emarginate, and on fertile branches thickened and acute . . . . 3. A. LASIOCARPA.

Resin ducts of the leaves close to the epidermis of the lower side.

Bracts of the cone-scales short-oblong, obcordate, laciniate and short-pointed at the apex; leaves dark green and very lustrous above, silvery white below, conspicuously emarginate, or on fertile branches sometimes bluntly pointed . . . . 4. A. GRANDIS.

Bracts of the cone-scales oblong, emarginate or nearly truncate at the broad denticulate short-pointed apex; leaves pale blue or glaucous, stomatiferous on the upper surface, rounded, acute, or acuminate; on fertile branches often falcate, and thickened and keeled above . . . . 5. A. CONCOLOR.

Bracts of the cone-scales rhomboidal or oblong-obovate, gradually narrowed into long slender tips, half as long as their scales; leaves crowded, dark green and very lustrous above, silvery white below, rounded, notched, or acute, or on fertile branches acute or acuminate, and occasionally stomatiferous on the upper surface . . . . 6. A. AMABILIS.

Bracteatæ. Leaves flat, slightly rounded, obscurely grooved, and without stomata on the upper surface, similar on sterile and fertile branches; tips of the bracts of the cone-scales elongated; winter-buds large, with thin loosely imbricated scales.

Bracts of the cone-scales oblong-obovate, obcordate, produced into elongated rigid flat tips, many times longer than their pointed glabrous scales; leaves dark yellow-green above, silvery white below, acuminate . . . . 7. A. VENUSTA.

Nobiles. Leaves blue-green, often glaucous, stomatiferous on both surfaces, bluntly pointed, flattened and grooved above or tetragonal on sterile branches, tetragonal, acute, incurved, and crowded on fertile branches.

Bracts of the cone-scales spatulate, full and rounded and fimbriate above, long-pointed, incurved, much longer than and nearly covering their scales; leaves distinctly grooved on the upper surface, rounded and often notched on sterile and acute or acuminate on fertile branches . . . . 8. A. NOBILIS.

Bracts of the cone-scales oblong-spatulate, acute or acuminate, or rounded above with slender tips, shorter or longer than their scales; leaves tetragonal, bluntly pointed on lower and acute on upper branches . . . . 9. A. MAGNIFICA.

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ABIES FRASERI.

Balsam Fir. She Balsam.

Bracts of the cone-scales oblong, rounded, short-pointed at the wide denticulate apex, much longer than their scales, reflexed. Leaves dark green and lustrous above, pale below, obtusely short-pointed, or occasionally emarginate.

Abies Fraseri, Poiret, *Lamarck Dict.* Suppl. v. 35 (1817). — Lindley, *Penny Cycl.* i. 30. — Rafinesque, *New Fl.* i. 39. — Lawson & Son, *Agric. Man.* 374. — Forbes, *Pinetum Woburn.* 111, t. 38. — Link, *Linnæa*, xv. 531. — Gray, *Man.* 441 (in part). — Nuttall, *Sylva*, iii. 139, t. 119. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 209. — Carrière, *Traité Conif.* 200. — Chapman, *Fl.* 434. — Curtis, *Rep. Geolog. Surv. N. Car.* 1860, iii. 26. — Henkel & Hochstetter, *Syn. Nadelh.* 169. — Sénéclauze, *Conif.* 8. — Hoopes, *Evergreens*, 202. — Bertrand, *Bull. Soc. Bot. France*, xviii. 379; *Ann. Sci. Nat.* sér. 5, xx. 95. — K. Koch, *Dendr.* ii. pt. ii. 216. — Engelmann, *Trans. St. Louis Acad.* iii. 596; *Proc. Phil. Acad.* 1876, 173; *Gardener's Monthly*, xix. 308. — Veitch, *Man. Conif.* 96. — Regel, *Russ. Dendr.* ed. 2, i. 43. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 210. — Lauche, *Deutsche Dendr.* ed. 2, 84. — Schübeler, *Virid. Norveg.* i. 431. — Mayr, *Wald. Nordam.* 217. — Masters, *Gard. Chron.* ser. 3, viii. 684, f. 132; *Jour. R. Hort. Soc.* xiv. 191. — Beissner, *Handb. Nadelh.* 462. — Hansen, *Jour. R. Hort. Soc.* xiv. 466 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 17, f. 7, J, K, L. — Britton & Brown, *Ill. Fl.* i. 57, f. 127.

Pinus Fraseri, Pursh, *Fl. Am. Sept.* ii. 639 (1814). — Sprengel, *Syst.* iii. 884. — D. Don, *Lambert Pinus*, iii. t. — Antoine, *Conif.* 76, t. 29, f. 1. — Endlicher, *Syn. Conif.* 91. — Lawson & Son, *List No. 10, Abietineæ*, 12. — Courtin, *Fam. Conif.* 57. — Dietrich, *Syn.* v. 393. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 419. — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 684, t. 47, f. 10.

Abies balsamea, β Fraseri, Nuttall, *Gen.* ii. 223 (1818). — Spach, *Hist. Vég.* xi. 422.

Pinus balsamea, Elliott, *Sk.* ii. 639 (not Linnæus) (1824).

Pinus balsamea, β Fraseri, Torrey, *Compend. Fl. N. States*, 359 (1826).

Picea Fraseri, Loudon, *Arb. Brit.* iv. 2340, f. 2243, 2244 (1838). — Knight, *Syn. Conif.* 39. — Gordon, *Pinetum*, 148.

A fast-growing, short-lived tree, usually from thirty to forty and rarely seventy feet in height, with a trunk occasionally two and a half feet in diameter.[1] The bark of the trunk is from one quarter to one half of an inch in thickness, and covered with thin closely appressed bright cinnamon-red scales, which generally become gray as the tree reaches maturity. The branches are slender and rather rigid, and spread in regular whorls, forming at first an open symmetrical pyramid, but frequently disappear from the lower part of the trunk before the tree has attained half its size. The winter-buds are obtuse, orange-brown, thickly coated with resin, and rarely more than an eighth of an inch in length. The branchlets, which are comparatively stout and covered for three or four years with fine pubescence, are pale yellow-brown during their first season, and then, becoming dark reddish brown during their first winter, gradually grow darker and often assume shades of purple. The leaves are crowded on the upper side of the branchlets, even on those of lower sterile branches, by the strong twist at their base, and are flat, obtusely short-pointed, or occasionally slightly emarginate at the apex even on fertile upper branches and leading shoots; they are very dark green and lustrous on the upper surface, marked on the lower with wide bands of from eight to twelve rows of stomata, and are from half an inch to nearly an inch in length, about one sixteenth of an inch broad, and often widest above the middle, with an almost continuous layer of hypoderm cells on their upper side and edges. The staminate flowers are oblong-cylindrical and about a third of an inch long, with yellow anthers tinged with red;

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[1] The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut on Roan Mountain, near the boundary between North Carolina and Tennessee, is fifteen inches in diameter inside the bark and one hundred and four years old. The stem of this tree, however, was only an inch and a half thick at the age of thirty years, while the sapwood, which is two inches in thickness, shows only eighteen layers of annual growth.

and the pistillate flowers are oblong-oval, with scales rounded above, much broader than they are long and shorter than their oblong pale yellow-green bracts rounded at the broad apex which terminates in a slender elongated tip, and denticulate and strongly reflexed above the middle. The cones are oblong-ovate or nearly oval, rounded at the somewhat narrowed apex, usually about two and a half inches in length and an inch and an eighth in thickness, with scales which are five eighths of an inch broad and twice as wide as they are long, dark purple and puberulous on the exposed portions, and at maturity nearly half covered by their pale yellow-green reflexed bracts. The seeds are an eighth of an inch in length and nearly as long as their dark lustrous wings, which are much expanded and very oblique at the apex.

Abies Fraseri, which grows only on the highest of the southern Appalachian mountains, where it is distributed from southeastern Virginia[1] through western North Carolina to Tennessee, often forms forests sometimes of considerable extent at elevations of between four and six thousand feet above the sea-level, giving to the upper slopes of these mountains their dark and sombre appearance, or mingles with the Red Spruce, the Yellow Birch, and the Hemlock.[2]

The wood of *Abies Fraseri* is very light, soft, not strong, and coarse-grained; it is pale brown, with nearly white sapwood, and contains broad inconspicuous bands of small summer cells and numerous thin medullary rays. The specific gravity of the absolutely dry wood is 0.3565, a cubic foot weighing 22.22 pounds. It has been occasionally manufactured into lumber for the construction of hotels and other buildings at high elevations on the mountains of North Carolina and Tennessee.

Abies Fraseri[3] was introduced into European gardens in 1811 by John Fraser,[4] who first made this tree known to science and whose labors as a botanical collector are kept green by its specific name. Short-lived and hardly distinct enough in habit and general appearance from the Balsam Fir of the north to be interesting to planters, *Abies Fraseri* has little to recommend it as an ornament of parks, from which, since the early years of its first introduction, it has probably almost completely disappeared, *Abies balsamea* raised from the seeds of cones with slightly exserted bracts gathered in Pennsylvania and New England being usually cultivated in the United States and England as *Abies Fraseri*. It has proved entirely hardy in the Arnold Arboretum, where it produces cones in abundance.

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[1] *Abies Fraseri* was found in May, 1892, on the slopes of Mt. Rogers, in Grayson County, southwestern Virginia, by N. L. and E. G. Britton and Anna Murray Vail.

[2] See Sargent, *Garden and Forest*, ii. 472, f. 132.

[3] *Abies Fraseri* is almost universally called the She Balsam by the mountaineers of North Carolina, in distinction to He Balsam, the name given by them to the Red Spruce.

[4] See i. 8.

EXPLANATION OF THE PLATE.

PLATE DCIX. ABIES FRASERI.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, seen from below, enlarged.
5. A branch with pistillate flowers, natural size.
6. A bract of a pistillate flower, lower side, enlarged.
7. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, lower side, with its bract, natural size.
10. A cone-scale, upper side, with its seeds and bract, natural size.
11. Vertical section of a seed, enlarged.
12. An embryo, enlarged.
13. Cross section of a leaf magnified fifteen diameters.
14. Winter-buds, natural size.
15. A seedling plant, natural size.

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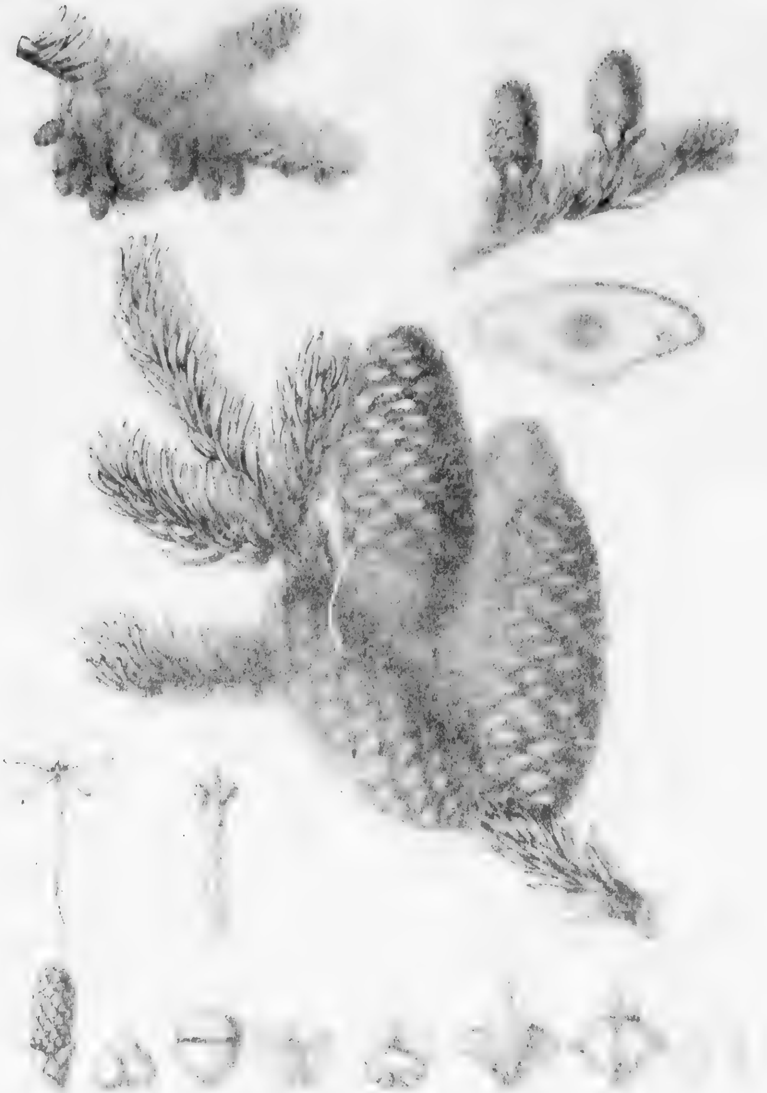

and the pistillate flowers are oblong-oval, with scales rounded above, much broader than they [illegible] and shorter than their oblong pale yellow-green bracts rounded at the broad apex which terminates in a slender elongated tip, and denticulate and strongly reflexed above the middle. The cones [illegible] oblong-ovate or nearly oval, rounded at the somewhat narrowed apex, usually about two and a [illegible] inches in length and an inch and an eighth in thickness, with scales which are five eighths of an inch [illegible] and twice as wide as they are long, dark purple and puberulous on the exposed portions, and [illegible] maturity nearly half covered by their pale yellow-green reflexed bracts. The seeds are an eighth of an inch in length and nearly as long as their dark lustrous wings, which are much expanded and [illegible] oblique at the apex.

Abies Fraseri, which grows only on the highest of the southern Appalachian mountains, where it is distributed from southeastern Virginia[1] through western North Carolina to Tennessee, often forming forests sometimes of considerable extent at elevations of between four and six thousand feet above the sea-level, giving to the upper slopes of these mountains their dark and sombre appearance, or mingled with the Red Spruce, the Yellow Birch and the Hemlock.[2]

The wood of *Abies Fraseri* is very light, soft, not strong and coarse-grained; it is pale brown with nearly white sapwood [illegible] inconspicuous [illegible] of small summer cells and numerous [illegible], a cubic foot weighing [illegible] occasionally manufactured into lumber for the construction of hotels and [illegible] on the mountains of North Carolina and Tennessee.

Abies Fraseri was introduced into European gardens in 1811 by John Fraser,[4] who first made it known to science and whose labors as a botanical collector are kept green by its specific name. [illegible] hardly distinct enough in habit and general appearance from the Balsam Fir of the north to be interesting to planters, *Abies Fraseri* has little to recommend it as an ornament of parks, from which, since the early years of its first introduction, it has probably almost completely disappeared, *Abies balsamea* raised from the seeds of cones with slightly exserted bracts gathered in Pennsylvania and New England being usually cultivated in the United States and England as *Abies Fraseri*. It has proved entirely hardy in the Arnold Arboretum, where it produces cones in abundance.

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[1] *Abies Fraseri* was found in May, [illegible], on the slopes of Mt. [illegible] in Grayson County, southwestern Virginia, by N. L. [illegible] [illegible]

[2] See Sargent, *Garden and Forest*, [illegible]

[illegible]

EXPLANATION OF THE PLATE.

PLATE [illegible]. ABIES FRASERI.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, seen from below, enlarged.
5. A branch with pistillate flowers, natural size.
6. A bract of a pistillate flower, lower side, enlarged.
7. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, lower side, with its bract, natural size.
10. A cone-scale, upper side, with its seeds and their wings, natural size.
11. Vertical section of a seed, enlarged.
12. An embryo, enlarged.
13. Cross section of a leaf, magnified fifteen diameters.
14. Winter branchlet, natural size.

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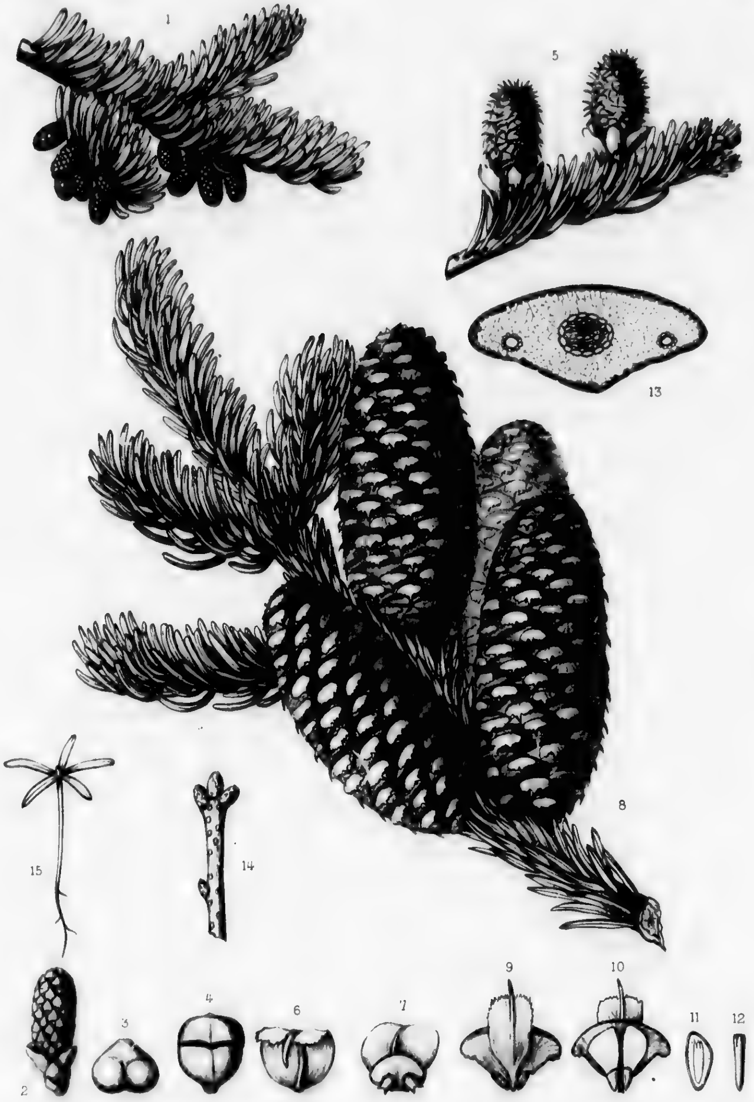

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ABIES FRASERI, Poir.

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ABIES BALSAMEA.

Balsam Fir. Balm of Gilead Fir.

Bracts of the cone-scales oblong, emarginate and short-pointed at the wide serrulate apex, shorter or slightly longer than their scales. Leaves dark green and lustrous above, pale below, obtusely short-pointed and occasionally emarginate, and on fertile branches acute or acuminate.

Abies balsamea, Miller, *Dict.* ed. 8, No. 3 (1768). — Poiret, *Lamarck Dict.* vi. 521. — Desfontaines, *Hist. Arb.* ii. 579. — Du Mont de Courset, *Bot. Cult.* ed. 2, vi. 474. — *Nouveau Duhamel*, v. 295, t. 83, f. 2. — Link, *Handb.* ii. 479; *Linnæa*, xv. 530. — Richard, *Comm. Bot. Conif.* 74, t. 16. — Ledebour, *Fl. Alt.* iv. 202. — Lindley, *Penny Cycl.* i. 30. — Lawson & Son, *Agric. Man.* 373. — Forbes, *Pinetum Woburn.* 109, t. 37. — Spach, *Hist. Vég.* xi. 421. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 210. — Carrière, *Traité Conif.* 217. — Darlington, *Fl. Cestr.* ed. 3, 291. — Henkel & Hochstetter, *Syn. Nadelh.* 176. — Sénéclauze, *Conif.* 6. — Hoopes, *Evergreens*, 197. — Regel, *Russ. Dendr.* pt. i. 20. — Bertrand, *Bull. Soc. Bot. France*, xviii. 379; *Ann. Sci. Nat.* sér. 5, xx. 95. — K. Koch, *Dendr.* ii. pt. ii. 214. — Nördlinger, *Forstbot.* 456. — Engelmann, *Trans. St. Louis Acad.* iii. 597. — Veitch, *Man. Conif.* 88. — Lauche, *Deutsche Dendr.* ed. 2, 84. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 210. — Schübeler, *Virid. Norveg.* i. 428. — Willkomm, *Forst. Fl.* ed. 2, 111. — Watson & Coulter, *Gray's Man.* ed. 6, 492. — Mayr, *Wald. Nordam.* 220, f. 6. — Beissner, *Handb. Nadelh.* 464. — Masters, *Jour. R. Hort. Soc.* xiv. 189; *Gard. Chron.* ser. 3, xvii. 422, f. 57, 58. — Hansen, *Jour. R. Hort. Soc.* xiv. 458 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 18. — Britton & Brown, *Ill. Fl.* i. 57, f. 126.

Pinus balsamea, Linnæus, *Spec.* 1002 (1753). — Du Roi, *Obs. Bot.* 40; *Harbk. Baumz.* ii. 103. — Moench, *Bäume Weiss.* 71; *Meth.* 364. — Evelyn, *Silva*, ed. Hunter, i. 279. — Wangenheim, *Beschreib. Nordam. Holz.* 37; *Nordam. Holz.* 40. — Burgsdorf, *Anleit.* pt. ii. 167. — Willdenow, *Berl. Baumz.* 218; *Spec.* iv. pt. i. 504; *Enum.* 989. — Aiton, *Hort. Kew.* iii. 370. — Castiglioni, *Viag. negli Stati Uniti*, ii. 314. — Borkhausen, *Handb. Forstbot.* i. 380. — Lambert, *Pinus*, i. 48, t. 31. — Persoon, *Syn.* ii. 579. — Pursh, *Fl. Am. Sept.* ii. 639. — Nuttall, *Gen.* ii. 223. — Hayne, *Dendr. Fl.* 176. — Richardson, *Franklin Jour.* Appx. No. 7, 752. — Sprengel, *Syst.* iii. 884. — Brotero, *Hist. Nat. Pinheiros, Larices e Abetos*, 31. — Lawson & Son, *List No. 10, Abietineæ*, 11. — Torrey, *Fl. N. Y.* ii. 229. — Hooker, *Fl. Bor.-Am.* ii. 163. — Bigelow, *Fl. Boston.* ed. 3, 385. — Antoine, *Conif.* 66, t. 26, f. 3. — Endlicher, *Syn. Conif.* 103. — Gihoul, *Arb. Rés.* 45. — Dietrich, *Syn.* v. 394. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 423. — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 684, t. 47, f. 11.

Pinus Abies balsamea, Muenchhausen, *Hausv.* v. 222 (1770). — Marshall, *Arbust. Am.* 102.

Pinus taxifolia, Salisbury, *Prodr.* 399 (1796).

Abies balsamifera, Michaux, *Fl. Bor.-Am.* ii. 207 (in part) (1803). — Michaux f. *Hist. Arb. Am.* i. 145, t. 14 (in part). — Rafinesque, *New Fl.* i. 39.

Pinus balsamea, var. longifolia, Lawson & Son, *List No. 10, Abietineæ*, 11 (1836).

Picea balsamea, Loudon, *Arb. Brit.* iv. 2339, f. 2240, 2241 (1838). — Knight, *Syn. Conif.* 39. — Gordon, *Pinetum*, 143. — (Nelson) Senilis, *Pinaceæ*, 37.

Picea balsamea, var. longifolia, Loudon, *Arb. Brit.* iv. 2339 (1838).

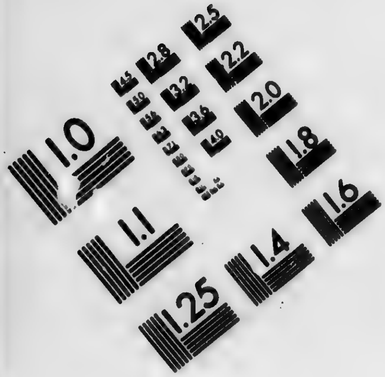
Picea balsamifera, Emerson, *Trees Mass.* 85 (1846); ed. 2, i. 101.

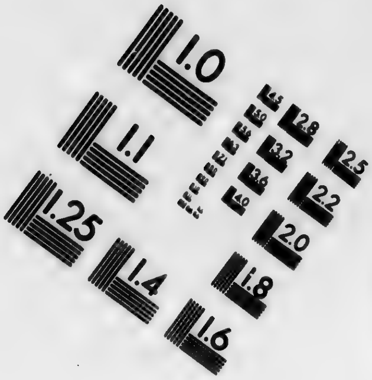
Picea Fraseri, Emerson, *Trees Mass.* 88 (not Loudon) (1846); ed. 2, i. 104.

Abies Fraseri, Gray, *Man.* 441 (in part) (not Poiret) (1848).

Abies Americana, Provancher, *Fl. Canadienne*, ii. 556 (excl. syn. *Abies Fraseri*) (not Miller nor Du Mont de Courset) (1862).

A tree, fifty or sixty feet in height, with a trunk usually from twelve to eighteen inches in diameter, but occasionally eighty feet tall, with a trunk thirty inches in diameter. During its first twenty years the branches, which at this period are elongated, horizontal, and very slender, are disposed in regular remote whorls of four or usually of five, the whole forming a handsome symmetrical open broad-based pyramid. Later the lower branches die when the tree is crowded in the forest, or, with sufficient space for their growth, become somewhat pendulous, while those toward the top of the tree, which in old age are short, crowded, and ascending, form a regular sharp-pointed slim spire-like head.





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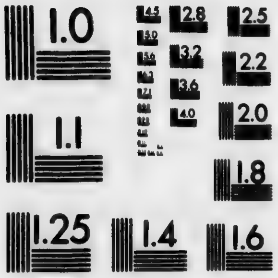

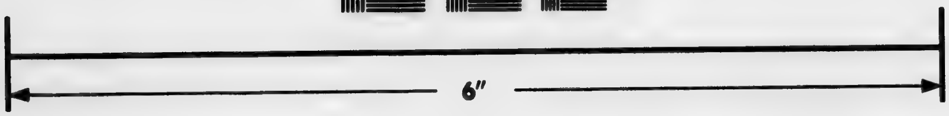

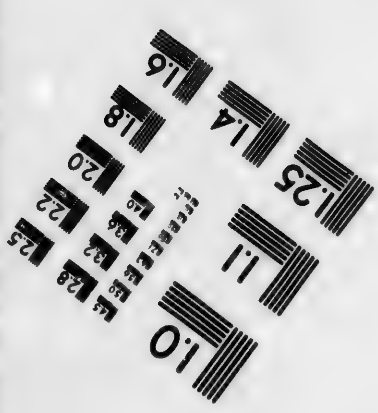

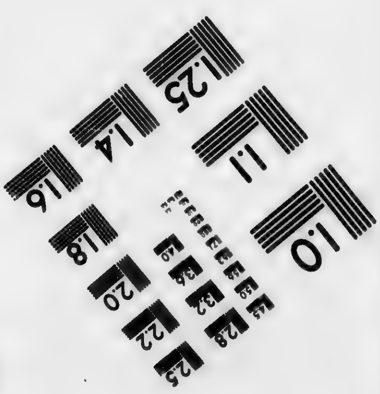

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The bark of the trunk of young trees is thin, smooth, pale gray, and conspicuously marked by the swollen resin chambers; on older trees it becomes, especially near the ground, sometimes nearly half an inch in thickness, and is reddish brown and much broken into small irregular plates separating on the surface into thin scales. The winter-buds are nearly globose and from an eighth to a quarter of an inch in diameter, with lustrous dark orange-green scales more or less tinged with red toward the apex. The branchlets are slender, and when they first appear are pale yellow-green and coated with fine pubescence which does not disappear for two or three years; during their second season they are light gray tinged with red, and, gradually growing darker, are often when four or five years old tinged with purple and more or less lustrous. On young trees and on sterile branches of old trees the leaves are linear-lanceolate, straight, and, spreading at nearly right angles to the branch, are remote or crowded; and on the upper branches of older trees they are often broadest above the middle, usually crowded, incurved and almost erect, and completely cover the upper side of the branchlets;[1] at the apex they are rounded or obtusely short-pointed and on vigorous young trees occasionally emarginate, or toward the top of the tree, especially on its leading shoot, they are acute or acuminate, with short or elongated rigid callous tips; they are dark green and lustrous on the upper surface, marked on the lower surface with bands of from four to eight but usually of six rows of stomata, which, silvery white and very conspicuous during the first season, lose much of their whiteness in their second year; the leaves are from half an inch in length on cone-bearing branches to an inch and a quarter on the sterile branches of young trees, and are nearly one sixteenth of an inch in width, their hypoderm cells, which are not numerous, being chiefly confined to the edges and the keel. The staminate flowers are oblong-cylindrical and about a quarter of an inch long, with yellow anthers more or less deeply tinged with reddish purple; and the pistillate flowers are oblong-cylindrical and about an inch in length, with nearly orbicular purple scales much shorter than their oblong-obovate serrulate pale yellow-green bracts, which at the broad apex are somewhat emarginate and abruptly contracted into long slender recurved tips. The cones are oblong-cylindrical, gradually narrowed to the rounded apex, puberulous, dark rich purple in color, from two and a half to four inches long and from an inch to an inch and a quarter thick, with scales which are usually rather longer than they are broad and generally almost twice as long as their bracts, although occasionally the ends of the bracts protrude from the scales of the mature cone. The seeds are about a quarter of an inch in length and rather shorter than their light brown lustrous wings.

From the interior of the Labrador peninsula, in about latitude 56° north, *Abies balsamea*, ranging southeastward, reaches the Atlantic coast near Cape Harrison, a degree farther south, and extends southwestward to the shores of Hudson Bay, near the mouth of the Great Whale River;[2] west of Hudson Bay it ranges from latitude 54° north to northern Manitoba, and, crossing by the hills of western Manitoba, the basin of the Saskatchewan, near Cumberland House, to the valley of the

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[1] Two forms of *Abies balsamea*, distinguished by Mr. Reginald C. Robbins of Boston in the region about Moosehead Lake, Maine, are probably generally distributed in the northeastern states; in the first the leaves are crowded along the upper sides of the branches by the strong twisting of their bases, and in the other they are less crowded, longer, more distichously spreading, obtuse and often emarginate even on upper branches, of tougher texture and of a darker and richer shade of green. The form with crowded leaves is a much more rapid-growing and usually a taller tree, generally inhabiting dense forests and soon deprived of its lower branches, while the form with remote spreading leaves grows more slowly, is usually furnished to the ground with branches, and commonly inhabits the borders of pastures and other open places. The two forms, however, often grow side by side under what appear to be precisely similar conditions. The fast-growing tree with crowded leaves is the only one cut in the neighborhood of Moosehead Lake for lumber.

An interesting form of the Balsam Fir, which reproduces itself from seeds, derived originally from the Woolf River region of Wisconsin, has been cultivated for several years in the Douglas Nurseries at Waukegan, Illinois. It is distinguished from the ordinary form of the Balsam Fir by its longer and more crowded leaves, sometimes an inch and a quarter long on sterile branches, and by its longer cones, which are often four and a half inches in length. This Fir, which is of unusually compact habit, promises to retain its lower branches more persistently than the ordinary Balsam Fir, and to be more valuable for the decoration of parks and gardens. (See *Garden and Forest*, v. 274.)

[2] See Bell, *The Scottish Geographical Magazine*, xiii. 283 (*The Geographical Distribution of Forest Trees in Canada*).

Churchill, extends down the Churchill to the divide which separates the waters of that river from those of the Athabasca, down this stream to the shores of Lake Athabasca, and up the Athabasca to the neighborhood of Fort Assiniboine and Lesser Slave Lake, the most northern point where it has been observed being in latitude 62° north.[1] Southward the Balsam Fir is spread over Newfoundland, the Maritime Provinces of Canada, Quebec, and Ontario, over northern New England, and through northern New York, northern Michigan and Minnesota to northeastern Iowa;[2] leaving the Atlantic coast near Portland, in southern Maine,[3] it ranges along the Appalachian Mountains through western Massachusetts, over the Catskills of New York and western Pennsylvania[4] to the high mountains of southwestern Virginia.[5] In Labrador *Abies balsamea* is scattered about the margins of lakes and large streams usually in moist alluvial soil;[6] on the lower Rupert and in the country adjacent to Lake Mistassinie it grows in abundance with the Aspen, the Canoe Birch, and the White Spruce. It is common in Newfoundland, the Maritime Provinces, and in Ontario and Quebec, growing usually in swamps or on higher ground near their borders.[7] In Manitoba and Saskatchewan it forms with the White Spruce dense forests on alluvial bottom-lands, and it occurs also but not commonly on plateaus and low hills up to elevations of twelve hundred feet above the streams. In the northeastern states and in the region of the Great Lakes the Balsam Fir is a common tree in all northern and elevated parts of the country, growing on low swampy ground and on well-drained hillsides, sometimes singly in forests of Spruces, Hemlocks, Pines, Birches, and Beeches, and sometimes in small almost impenetrable thickets; and, occasionally ascending to high elevations on the mountains of New England and New York, it is reduced near their timber-line to a low nearly stemless shrub with wide-spreading prostrate branches.[8] South of Maine and New Hampshire the Balsam Fir is found only west of the Connecticut River, and is less abundant and of smaller size than farther north, growing in high cool situations, where its roots are rarely without the abundant supplies of moisture which are essential for its welfare.

The wood of *Abies balsamea* is very light, soft, not strong, coarse-grained, and perishable; it is pale brown often streaked with yellow, with thick lighter colored sapwood, and contains conspicuous narrow bands of small summer cells and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.3819, a cubic foot weighing 23.80 pounds. It is occasionally made into cheap lumber, principally used for packing-cases. From the bark of this tree Canadian Balsam, or Balm of Fir, used in the arts, and in medicine chiefly in the treatment of chronic affections of the mucous membrane, is obtained.[9]

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[1] Richardson, *Arctic Searching Exped.* ii. 316.

[2] In 1882 Mr. E. W. D. Holway found a single tree of *Abies balsamea* near Decorah in Winneshiek County, Iowa. It has also been found in the adjacent county of Alamakee, in the extreme northeastern corner of the state. (*Teste* L. H. Pammel.)

[3] In May, 1881, Mr. John Robinson found *Abies balsamea* on Goose Island, Portland Harbor.

[4] Rothrock, *Rep. Dept. Agric. Penn.* 1895, pt. ii. *Div. Forestry*, 284.

[5] In June, 1892, Mr. John K. Small found *Abies balsamea* on the summit of Mt. Rogers, in Grayson County, Virginia, at an elevation of five thousand seven hundred and nineteen feet above the level of the sea.

[6] Low, *Rep. Geolog. Surv. Can.* ser. 2, viii. pt. i. 35 L.

[7] Provancher, *Flore Canadienne*, ii. 555. — Brunet, *Cat. Vég. Lig. Can.* 57. — Macoun, *Cat. Can. Pl.* 473.

[8] One of these dwarf forms of the Balsam Fir, a low cushion-like plant which does not appear to have produced cones, has long been an inhabitant of gardens. It is: —

Abies balsamea Hudsonia, Engelmann, *Trans. St. Louis Acad.* iii. 597 (1878). — Veitch, *Man. Conif.* 83. — Beissner, *Handb. Nadelh.* 465.

Picea Fraseri Hudsonia, Knight, *Syn. Conif.* 39 (1850).

Abies Fraseri (β) *nana*, Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 209 (1850).

Abies Fraseri, var. *Hudsoni*, Carrière, *Traité Conif.* 200 (1855).

Picea Fraseri Hudsonica, Gordon, *Pinetum*, 148 (1858).

[9] The gathering of Canada Balsam, which is chiefly a Canadian industry, although it is sometimes collected in the northeastern United States, is carried on in the province of Quebec only by the poorest white people and by Indians, who camp in the woods from the middle of June until the middle of August, the season when it is usually gathered, the women cooking and keeping the camps, while the men and children gather the balsam. This is done with small iron cans, furnished at the top with iron tubes sharpened at the end. The tube is pressed against the resin blister, punctures it, and the gum flows down the tube into the can. The yield of a large tree is about one pound, although the average yield is not more than half a pound. One man can gather about half a gallon of the gum in a day, but with the assistance of his children, who climb into the upper limbs while the father works near the ground, the yield of a day's work for the family is often a gallon. Canada Balsam can be collected only on pleasant days and when the leaves of the tree are dry, as the water shaken from the branches, mixing

First described in 1704[1] from trees which were then growing in England in the gardens of the Duchess of Beaufort[2] at Badmington and of Bishop Compton[3] in London, the value of the Balsam Fir for several domestic uses had been known for at least a century earlier to the colonists of Canada[4] and New England.[5] Hardy and fast-growing, of a cheerful color and in early years of vigorous and rapid growth, it was at one time popular in the northern states for the decoration of country door-yards. But, too often prematurely old, the naked trunks of these planted trees, surmounted with crowns of scanty half-dead foliage, show that the beauty of the Balsam Fir cannot long survive its removal from the cold moist northern forests which are its home, and in which, even under the most favorable conditions, it rarely outlives a century. Before the introduction of the Fir-trees of eastern Europe, of Asia, and of western America, when *Abies balsamea* was one of the few exotic coniferous trees cultivated in western Europe, it was a favorite inmate of plantations in England, France, Belgium, and Germany, where it now seldom survives.[6] Several forms, differing from the normal in their habit of growth or in the color or length of their leaves, are still occasionally propagated by nurserymen.[7]

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with the gum in the cans, makes it milky and unsalable. (See Saunders, *Proc. Am. Pharm. Assoc.* xxv. 337.)

Canada Balsam is a transparent straw-colored resin faintly tinged with green, and of the consistency of honey, with a pleasant aromatic odor and a slightly bitter flavor. A colorless oil is obtained from it by distillation in water. Formerly largely used for its stimulating action on the mucous membrane, it is now rarely employed in medicine, and is chiefly used for mounting objects to be examined under the microscope, for which purpose it is highly esteemed, as it remains constantly transparent and uncrystallized. (See Schoepf, *Mat. Med. Amer.* 143. — Stokes, *Bot. Mat. Med.* iv. 424. — Griffith, *Med. Bot.* 605, f. 268. — Nees von Esenbeck, *Pl. Med.* 82. — Stephenson & Churchill, *Med. Bot.* ii. t. 74. — Descourtils, *Fl. Med. Antill.* iv. 59, t. 246 (excl. hab. Nouvelle Orléans). — Lindley, *Fl. Med.* 554. — Woodville, *Med. Bot.* ed. 3, v. t. 1. — Flückiger & Hanbury, *Pharmacographia*, 555. — Bentley & Trimen, *Med. Pl.* iv. 263, t. 263. — Flückiger, *Pharmakognosie der Pflanzenreiches*, 70; *Am. Jour. Pharm.* liii. 593 [*Note on the early history of Canada Balsam*]. — Johnson, *Man. Med. Bot. N. A.* 258. — *U. S. Dispens.* ed. 16, 1487. — Bastin & Trimble, *Am. Jour. Pharm.* lxviii. 554.)

[1] *Arbor Balsamum Gileadense fundens*, Ray, *Hist. Pl.* 111, *Dendr.* 8.
Abies; Taxi foliis; odora Balsami Gileadensis, Miller, *Dict.* No. 7.
Abies taxi folio, odore Balsami Gileadensis, Duhamel, *Traité des Arbres*, i. 3.

[2] See ix. 19.

[3] See i. 6.

[4] "Mais des Sapins, et Pins, se pourra tire un bon proufit, parce qu'ils rendent de la gomme fort abondamment, et meurent bien souvent de trop de graisse. Cette gomme est belle come la Terebentine de Venise, et fort souveraine à la Pharmacie." (Lescarbot, *Histoire de la Nouvelle France*, ed. Tross, iii. 820.)

"Il y a des Sapins comme en France: toute la difference que j'y trouve, c'est qu à la pluspart il y vient des bubons à l'écorce, qui sont remplies d'une certaine gomme liquide qui est aromatique, dont on se sert pour les playes comme des baûmes, et n'a pas gueres moins de vertu, selon le rapport de ceux qui ont fait l'experience." (Pierre Boucher, *Histoire Veritable et Naturelle des Mœurs et Productions du Pays de la Nouvelle France, vulgairement dite le Canada*, ed. 3, 49.)

[5] "The Firr-tree is a large tree, too, but seldom so big as the Pine, the bark is smooth, with knobs or blisters, in which lyeth clear liquid Turpentine very good to be put into salves and oyntments, the leaves, or cones boiled in beer are good for the Scurvie, the young buds are excellent to put into Epithemes for Warts and Corns, the rosen is altogether as good as frankincense. . . . The knots of this tree and fat-pine are used by the *English* instead of candles, and it will burn a long time, but it makes the people pale." (Josselyn, *An Account of Two Voyages to New England*, 66.)

"The *Firr Tree*, or *Pitch Tree*, the Tar that is made of all sorts of *Pitch Wood*, is an excellent thing to take away those desperate Stitches of the Sides, which perpetually afflicteth those poor People that are stricken with the *Plague of the Back*." (Josselyn, *New England's Rarities*, 62.)

[6] See Wesmael, *Garden and Forest*, iii. 494.

[7] None of the garden forms of *Abies balsamea*, with the exception of the var. *Hudsonia*, are sufficiently interesting or distinct to repay cultivation. (For their enumeration see Carrière, *Traité Conif.* 217. — Gordon, *Pinetum*, 144. — Beissner, *Handb. Nadelh.* 464.)

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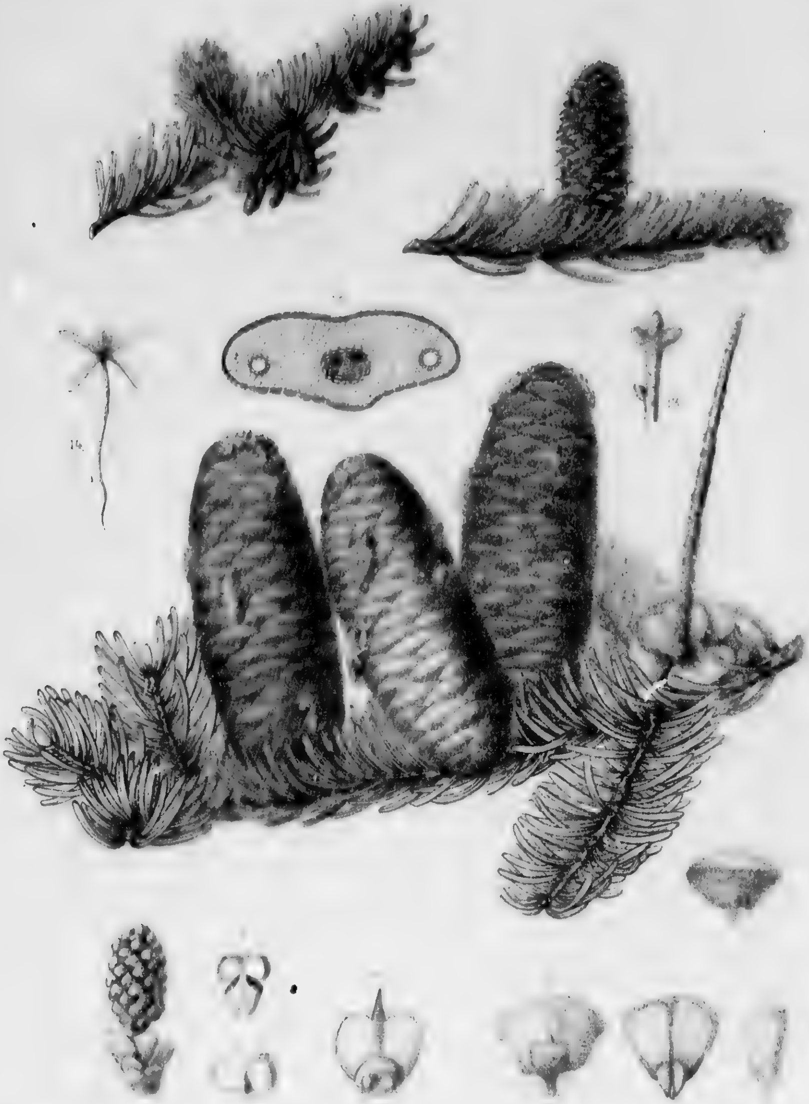
EXPLANATION OF THE PLATE.

Plate DCX. Abies balsamea.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, seen from below, enlarged.
4. An anther, side view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. A cone-scale of the long-coned Wisconsin form, upper side, with its bract, natural size.
11. A seed, enlarged.
12. Cross section of a leaf, magnified fifteen diameters.
13. Winter-buds, natural size.
14. A seedling plant, natural size.



[illegible] BALSAMEA, [illegible]

EXPLANATION OF THE PLATE.

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7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
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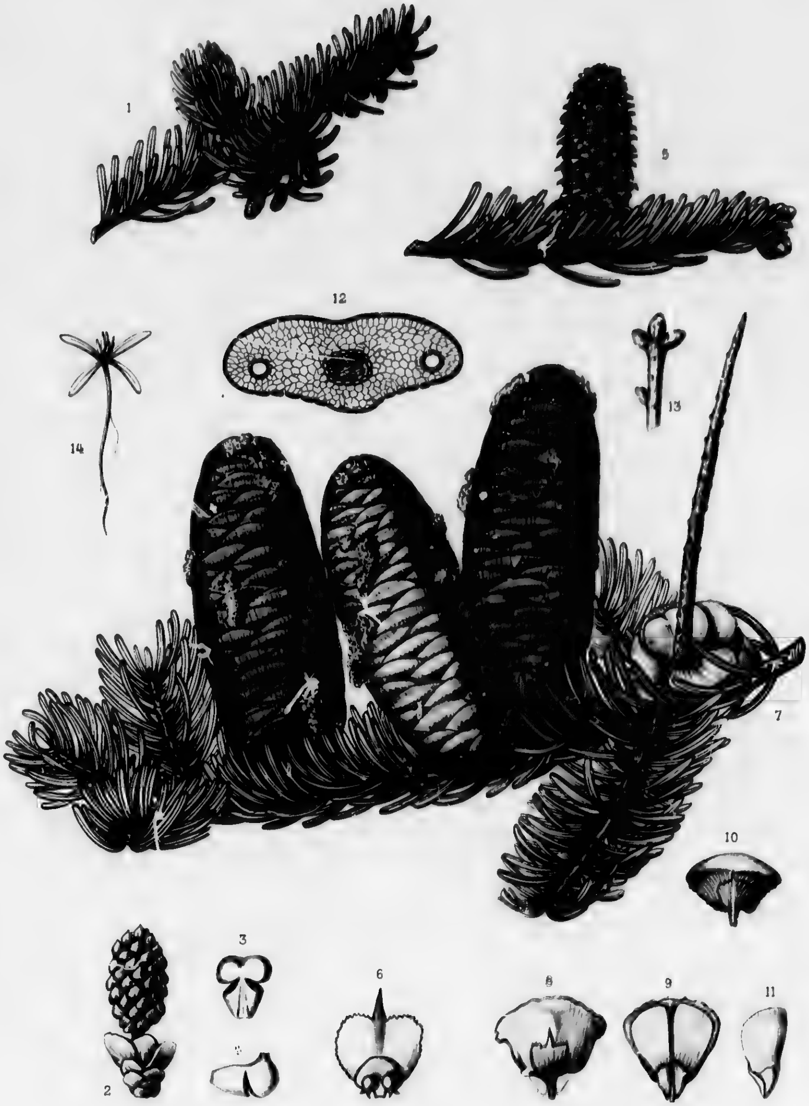

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ABIES BALSAMEA, Mill

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ABIES LASIOCARPA.

Balsam Fir.

Bracts of the cone-scales oblong-obovate, laciniate, rounded, emarginate, and long-pointed at the apex, much shorter than the scales. Leaves blue-green and glaucous, stomatiferous on the upper surface, rounded or bluntly pointed and occasionally emarginate, and on fertile branches thickened and acute.

Abies lasiocarpa, Nuttall, *Sylva*, iii. 138 (1849). — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 210. — Carrière, *Traité Conif.* 221. — A. Murray, *Proc. R. Hort. Soc.* iii. 318, f. 10–14; *Gartenflora*, xiii. 118. — Henkel & Hochstetter, *Syn. Nadelh.* 161 (in part). — Lauche, *Deutsche Dendr.* ed. 2, 84. — Masters, *Gard. Chron.* ser. 3, v. 172, f. 23–27, 32; *Jour. Bot.* xxvii. 129, f.; *Jour. R. Hort. Soc.* xiv. 192. — Lemmon, *Rep. California State Board Forestry*, iii. 149 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 60; *Bull. Sierra Club*, ii. 163 (*Conifers of the Pacific Slope*). — Leiberg, *Contrib. U. S. Nat. Herb.* v. 49.

Pinus lasiocarpa, Hooker, *Fl. Bor.-Am.* ii. 163 (1839). — Endlicher, *Syn. Conif.* 105. — Dietrich, *Syn.* v. 394. — Courtin, *Fam. Conif.* 57. — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 682, t. 46, f. 7, 7 a; 47, f. 8, 9.

Pinus sp., Torrey, *Frémont's Rep.* 97 (1845).

Abies balsamea, J. M. Bigelow, *Pacific R. R. Rep.* iv. pt. v. 18 (in part) (not Miller) (1856). — Torrey, *Pacific R. R. Rep.* iv. pt. v. 141 (in part).

Abies grandis, Engelmann, *Am. Jour. Sci.* ser. 2, xxxiv. 330 (not Lindley) (1862). — Carrière, *Traité Conif.* ed. 2, 296 (in part). — Watson, *King's Rep.* v. 334 (in part). — Porter & Coulter, *Fl. Colorado; Hayden's Surv. Misc. Pub.* No. 34, 131.

Picea amabilis, Gordon, *Pinetum*, 154 (in part) (not Loudon) (1858).

Abies bifolia, A. Murray, *Proc. R. Hort. Soc.* iii. 320, f. 34–39 (1863); *Gartenflora*, xiii. 119; *Gard. Chron.* n. ser. iii. 465, f. 96, 97. — Henkel & Hochstetter, *Syn. Nadelh.* 420. — Masters, *Gard. Chron.* ser. 3, v. 172, f. 28–31.

Pinus amabilis, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 426 (in part) (not Antoine) (1868).

Picea bifolia, A. Murray, *Gard. Chron.* n. ser. iii. 106 (1875).

Picea lasiocarpa, A. Murray, *Gard. Chron.* n. ser. iv. 135, f. 27, 194; f. 39 (1875).

Abies subalpina, Engelmann, *Am. Nat.* x. 555 (1876); *Trans. St. Louis Acad.* iii. 597; *Rothrock Wheeler's Rep.* vi. 255. — Masters, *Gard. Chron.* n. ser. xv. 236, f. 43–45; *Jour. Linn. Soc.* xxii. 183, f. 12–17. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 211. — Coulter, *Man. Rocky Mt. Bot.* 430. — Mayr, *Wald. Nordam.* 355. — Beissner, *Handb. Nadelh.* 466. — Hansen, *Jour. R. Hort. Soc.* xiv. 477 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 17, f. 7, D–F. — F. Kurtz, *Bot. Jahrb.* xix. 425 (*Fl. Chilcatgebietes*).

Abies subalpina, var. fallax, Engelmann, *Trans. St. Louis Acad.* iii. 597 (1878).

Abies Arizonica, Merriam, *Proc. Biol. Soc. Washington*, x. 115, f. 24, 25 (1896). — Lemmon, *Bull. Sierra Club*, ii. 167 (*Conifers of the Pacific Slope*).

Abies lasiocarpa, var. Arizonica, Lemmon, *Bull. Sierra Club*, ii. 167 (*Conifers of the Pacific Slope*) (1897).

A tree, occasionally one hundred and seventy-five feet in height, with a trunk five feet in diameter, but usually from eighty to one hundred feet tall, with a trunk two or three feet thick, and at high elevations often reduced to a low bush with spreading prostrate stems. The bark, which on young stems is thin, smooth, and pale gray or silvery white, on old trees is from three quarters of an inch to an inch and a half in thickness, divided by shallow fissures and roughened by thick closely appressed scales which are light reddish brown or nearly white on the surface, and occasionally soft and spongy.[1]

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[1] Corky bark is particularly noticeable on trees on the San Francisco Peaks of Arizona, where a similar peculiarity characterizes the bark of *Abies concolor* and *Pseudotsuga mucronata*. Upon the strength of the spongy bark of the Arizona trees and of some peculiarity in the form of their cone-scales Dr. Merriam established his *Abies Arizonica*. I have seen bark equally corky, however, on *Abies lasiocarpa* in Colorado and eastern Oregon and in southern Alberta and British Columbia, as also the scales of cones produced by trees on the Blue Mountains of Oregon, which in shape cannot be distinguished from those which grow on the San Francisco Peaks.

The short crowded tough branches, which are usually slightly pendulous below, generally clothe the trunks of the oldest trees to nearly their base and form dense spire-like sharp-pointed heads which are remarkable, even among Fir-trees, for their extreme slenderness;[1] or sometimes the lower branches perish on the largest individuals, leaving the massive trunks naked for fifty or sixty feet. The winter-buds are subglobose, from an eighth to a quarter of an inch in thickness, very resinous, and covered by light orange-brown scales. The branchlets are comparatively stout and are coated during three or four years with fine rufous pubescence, or rarely become glabrous before the end of their first season; when they emerge from the buds they are pale orange-brown, and, growing lighter colored during their second season, become gray or silvery white. The leaves are flat, with hypoderm cells which form a broken band under the epidermis on the upper side and are crowded along the edges and keel; they are blue-green, very glaucous during their first season, marked on the upper surface but generally only above the middle with four or five rows of stomata on each side of the conspicuous midgroove, and on the lower surface with two broad bands each of seven or eight rows of stomata; they are crowded and nearly erect by the twist at their base, and on lower branches are from an inch to an inch and three quarters long, about one twelfth of an inch wide, and rounded and occasionally emarginate at the apex; and on upper and fertile branches they are somewhat thickened and usually acute, with short callous tips, and generally not more than half an inch long, while on the leading shoot they are flattened, closely appressed, and terminate in long slender rigid points. The staminate flowers are cylindrical, from one half to three quarters of an inch in length and an eighth of an inch in thickness, with dark indigo-blue anthers turning to violet when nearly ready to open; and the pistillate flowers are oblong-cylindrical and an inch in length, with dark violet-purple obovate scales much shorter than their bracts, which are contracted into slender tips about a third of an inch long, and strongly reflexed. The cones are oblong-cylindrical, rounded, truncate, or depressed at the somewhat narrowed apex, from two and a half to four inches long and about an inch and a half thick; their scales are gradually narrowed from the broad rounded or nearly truncate apex to the base, and, although usually longer than they are broad, are sometimes much broader than they are long; they are dark purple and puberulous on the exposed parts, and about three times the length of their bracts, which are oblong-obovate, laciniately cut on the margins, rounded, emarginate, and abruptly contracted at the apex into long slender tips, and dark red-brown.[2] The seeds are about a quarter of an inch in length, with deep violet-colored lustrous wings which cover nearly the entire surface of the scales, and often become pale yellow-brown in drying.

Abies lasiocarpa is an inhabitant of high mountain slopes and summits, and is distributed from at least latitude 61° north in Alaska[3] southward along the coast ranges to the Olympic Mountains of Washington, and over all the high ranges of British Columbia and Alberta; it extends along the Cascade Mountains of Washington and Oregon,[4] over the mountain ranges of eastern Washington and Oregon, and of Idaho, Montana, Wyoming, Colorado, and Utah, and finds its most southerly home on

[1] The slender spire-like habit of this tree, which always characterizes it and makes it easily distinguishable from the other Firs of western North America, is well shown in the illustration on page 380 of the fourth volume of *Garden and Forest*, which represents it growing with *Tsuga Mertensiana* near the timber-line on Mt. Rainier in Washington.

[2] The cone-scales of *Abies lasiocarpa* vary more in shape than those of any other North American Fir-tree and are of little diagnostic value. I have seen them in Montana seven eighths of an inch long and three quarters of an inch wide, and in Arizona and Oregon nearly an inch wide and half an inch long, while an examination of a large series of cones from different parts of the country has shown all sorts of variations within these extreme limits of size.

[3] See G. M. Dawson, *Garden and Forest*, i. 58; *Rep. Geolog. Surv. Can.* n. ser. iii. pt. i. Appx. i. 186 B. — Macoun, *Rep. Geolog. Surv. Can.* n. ser. iii. pt. i. Appx. iii. 226 B.

[4] The most southern point at which *Abies lasiocarpa* has been noticed on the Cascade Mountains is at an elevation of five thousand two hundred feet above the sea about ten miles south of Crater Lake, near the extreme southern end of the range (*teste* E. I. Applegate).

It is a curious fact that this tree has been unable to cross the lava-covered plains south of the southern end of the Cascade Mountains to Mt. Shasta, and that it is entirely absent from the high California mountains, although *Tsuga Mertensiana*, its constant companion on the northern coast mountains and on the Cascade Range, abounds on Mt. Shasta and extends far southward along the Sierra Nevada.

the San Francisco Peaks of northern Arizona. On the coast mountains of Alaska[1] it forms the timber-line up to elevations of five thousand feet above the sea-level, growing almost habitually in the coast region with *Tsuga Mertensiana*, and near the head of the Lewes River, in latitude 60°, descending to the shores of Lake Bennett, where it is very abundant at elevations of two thousand one hundred and fifty feet. In southern British Columbia, on the Selkirk Mountains, where it grows perhaps to its largest size, *Abies lasiocarpa* is scattered through dense forests composed principally of the western Hemlock, the Patton Spruce, and the Engelmann Spruce, and in all the northern Rocky Mountain region of the United States, where, north of Colorado, it is the only Fir-tree east of the continental divide, it grows on wet subalpine slopes and plateaus near the timber-line, sometimes forming groves in park-like openings of the forest, and with the Engelmann Spruce, at elevations of over eight thousand feet above the sea, covers the bottoms of deep cañons with continuous forests;[2] on the Cascade and Olympic Mountains it forms the timber-line with *Tsuga Mertensiana* on high wind-swept rocky ridges at elevations of from four thousand to nearly eight thousand feet above the sea,[3] and on the Blue and Powder River Mountains and the other ranges in the interior of Washington and Oregon it grows with the White Fir and the Lodge Pole Pine, and reaches the upper limits of tree-growth; in Colorado it is widely distributed, growing usually in the neighborhood of streams at elevations of between seven and ten thousand feet above the sea, sometimes forming small groves, but more often scattered among Aspens and Spruces, and occasionally ascending to eleven thousand feet above the sea.[4] On the San Francisco Peaks it principally inhabits northern slopes between elevations of nine and ten thousand feet, scattered singly or in small masses through the forests of *Picea Engelmanni* and *Pinus aristata*.[5]

The wood of *Abies lasiocarpa* is very light, soft, and not strong nor durable; it is pale brown or nearly white, with lighter colored sapwood, and contains inconspicuous narrow bands of small summer cells and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.3476, a cubic foot weighing 21.66 pounds. It is probably little used except as fuel.

Abies lasiocarpa was, no doubt, one of the Pine-trees which Lewis and Clark noticed in September, 1805, when they crossed the Bitter Root Mountains in their journey to the Pacific Ocean.[6] Nothing more was heard of it until it was found by David Douglas, who collected in the "interior of N. W. America," during his second journey to this country in 1832, a meagre specimen from which the first description of this tree was made, although it was not well understood until 1876, when Engelmann was first able to point out its true characters.

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[1] "Near Telegraph Creek, a tributary of the Skeena River, in about latitude 58° north on the east side of the coast mountains, the Firs grow higher than other trees, dwarfing at a height of about five thousand feet into low chaparral. This dwarfing seems to be due as much to heavy snow as to altitude, for at the same elevation on ridges where the snow can never be deep the dwarf and erect forms grow close together. This Fir forms beautiful chaparral, the flat thickly foliaged plumes, broad and fan-shaped, being imbricated over each other by the pressure of the snow, so that the high slopes seem to be neatly and handsomely thatched. In this form it is seldom more than three feet high, yet the bushes bear fertile cones and seem thrifty and happy as if everything were to their mind. In this dwarfed form it reaches a height of five thousand five hundred feet. At a height of four thousand feet the trees are erect and more than fifty feet high and one foot in diameter at the ground. The Pine and Spruce of the region lying between the head of Deuse Lake and Telegraph Creek in great part give place to this handsome Fir around the lake, and upward to the north and on the mountains, the tallest being about one hundred feet high and one foot in diameter at the ground and feathered with short branches from top to bottom. The cones, which are three inches long and one inch in diameter, are dark purple, with short dark-colored bracts and very dark seed-wings. The mountain side and the slopes on the west side of the lake is forested with this tree." (Muir *in litt.*)

Abies lasiocarpa, which grows up to elevations of fully five thousand feet at the head of the passes which cross the coast mountains in latitude 60°, probably grows much farther north on the mountains of the valley of the Yukon River, although I have not been able to find any record of its existence on these mountains, which are still very imperfectly explored.

It is stated by Dr. George M. Dawson, the director of the Geological Survey of Canada, that *Abies lasiocarpa* crosses the Rocky Mountains into the Peace River region, and grows in cold, damp situations in the country between Lesser Slave Lake and the Athabasca River (*Can. Nat.* n. ser. ix. 326. See, also, Macoun, *Cat. Can. Pl.* 474). I have not been able to see specimens, however, from any point east of the Rocky Mountains.

[2] Tweedy, *Fl. Yellowstone National Park*, 11, 74.

[3] On Mt. Rainier, in Washington, the highest of the volcanic peaks of the Cascade Range, *Abies lasiocarpa* grows from four thousand five hundred feet to the extreme upper limits of tree-growth, which is at nearly eight thousand feet. At its lowest levels it grows with *Abies nobilis* and *Abies amabilis*; leaving them between five and six thousand feet, it attains its best size two thousand feet higher, its associate at high elevations being always *Tsuga Mertensiana*; above seven thousand feet it clings close to the ground with semiprostrate stems forming great mats of thick branches which, with dwarf plants of the Mountain Hemlock and *Pinus albicaulis*, cover the most exposed ridges.

[4] Brandegee, *Bot. Gazette*, iii. 33.

[5] Merriam, *North American Fauna*, No. 3, 120.

[6] *History of the Expedition under Command of Lewis and Clark*, ed. Coues, ii. 598. See, also, Sargent, *Garden and Forest*, x. 20.

Abies lasiocarpa was probably introduced into gardens by Dr. C. C. Parry, who found it in Colorado in 1862 and collected its seeds the following year. Little is known of it as a cultivated plant. The Rocky Mountain Balsam probably always grows slowly,[1] and in western Europe it suffers from early spring frosts.[2] It was first raised in the Arnold Arboretum from seeds gathered by Dr. Parry in Colorado in 1873, and although it is perfectly hardy in eastern Massachusetts, the largest of the plants raised from these seeds is now only ten feet high.[3]

The most widely distributed of the Fir-trees of the New World, ranging through thirty degrees of latitude, and from the coast mountains of the north, bathed in almost continuous moisture, to the arid mountains of Colorado and Arizona, *Abies lasiocarpa* lives on for centuries safe in its thin needle-like head, which offers the least possible resistance to the gales that sweep over it continuously, and in its tough branches, which no weight of snow can crush, rejoicing in its hardiness and vigor and seeming as enduring as the rivers of ice which often flow at its feet.

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[1] The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut in Colorado, is only fifteen and three quarters inches in diameter inside the bark and one hundred and thirty-eight years old, the sapwood, which is three quarters of an inch thick, showing twenty-eight layers of annual growth.

[2] At least one plant raised from seeds said to have been collected by Roezl somewhere in North America in 1874, and probably in Colorado, was alive in England in 1888. (See Syme, *Gard. Chron.* ser. 3, iii. 586.)

[3] Among the plants raised in 1873 in the Arnold Arboretum is one only a few inches high, with spreading prostrate stems, which promises to prove an interesting addition to the dwarf conifers that are highly prized by many lovers of curious trees.

EXPLANATION OF THE PLATE.

Plate DCXI. Abies lasiocarpa.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A scale of a pistillate flower, upper side, with its ovules and bract.
7. A bract of a pistillate flower, lower side, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, lower side, with its bract, natural size.
10. A cone-scale, upper side, with its seeds, natural size.
11. A cone-scale, lower side, with its bract, natural size (from the Blue Mountains of Oregon).
12. A cone-scale, with its bract, lower side, natural size (from the San Francisco Peaks, Arizona).
13. A cone-scale, upper side, with one seed removed, natural size (from the San Francisco Peaks, Arizona).
14. A seed, natural size.
15. Vertical section of a seed, enlarged.
16. An embryo, enlarged.
17. The end of a lateral branch, natural size.
18. Cross section of a leaf, magnified fifteen diameters.
19. Winter-buds, natural size.

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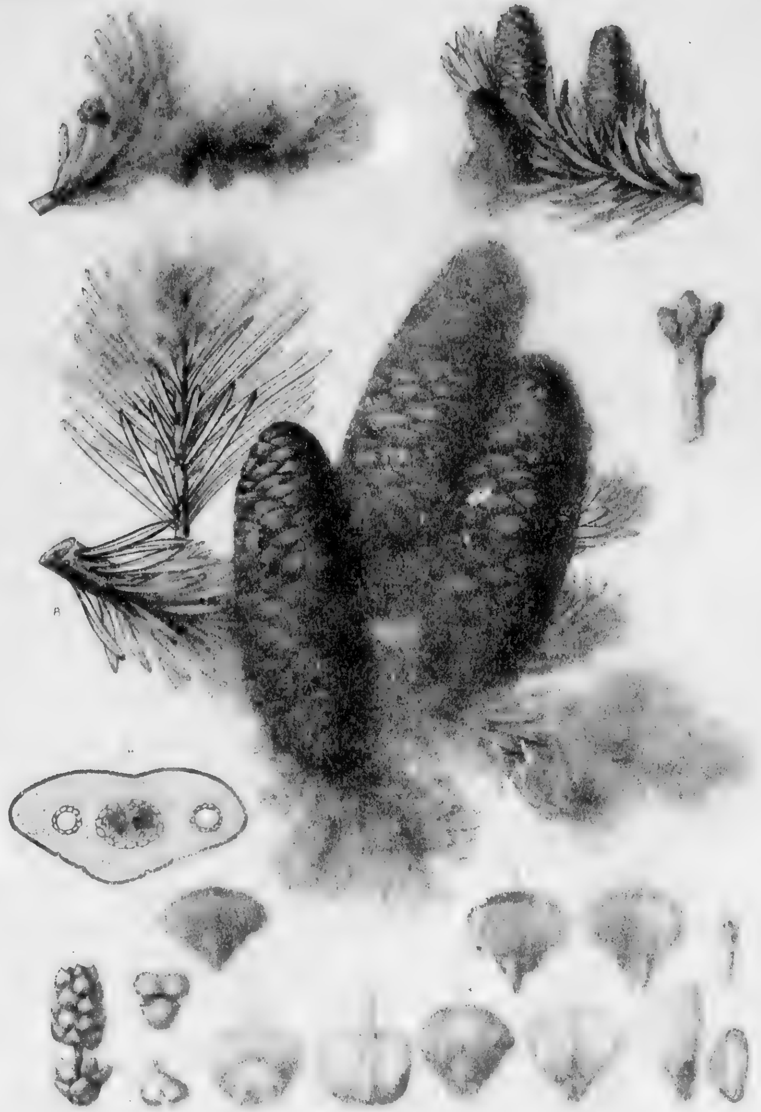

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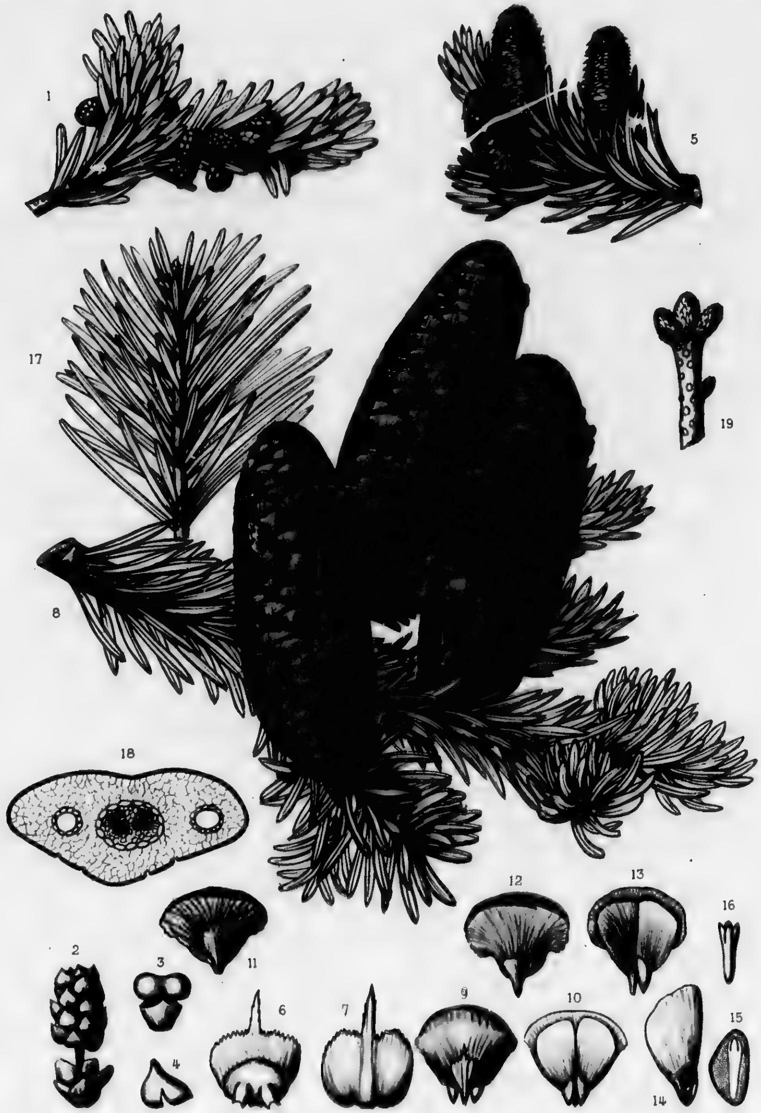

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ABIES GRANDIS.

White Fir.

Bracts of the cone-scales short-oblong, obcordate, laciniate and short-pointed at the apex, much shorter than their scales. Leaves dark green and very lustrous above, silvery white below, conspicuously emarginate, or on fertile branches sometimes bluntly pointed.

Abies grandis, Lindley, *Penny Cycl.* i. 30 (1833). — Forbes, *Pinetum Woburn.* 123, t. 43. — Spach, *Hist. Vég.* xi. 422. — Nuttall, *Sylva*, iii. 134. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 210. — Carrière, *Traité Conif.* 220. — Cooper, *Pacific R. R. Rep.* xii. pt. ii. 25, 69. — Lyall, *Jour. Linn. Soc.* vii. 143. — Henkel & Hochstetter, *Syn. Nadelh.* 160. — (Nelson) Senilis, *Pinaceæ*, 38. — Sénéclauze, *Conif.* 9. — Hoopes, *Evergreens*, 211. — Engelmann, *Trans. St. Louis Acad.* iii. 598 (excl. var. *densiflora*); *Gard. Chron.* n. ser. xii. 684; xiv. 720, f. 138; *Brewer & Watson Bot. Cal.* ii. 118. — Masters, *Gard. Chron.* n. ser. xv. 179, f. 33–36, xvii. 400; xxiv. 563, f. 128–131; *Jour. Linn. Soc.* xxii. 174, t. 3, f. 4, 5; *Jour. R. Hort. Soc.* xiv. 192. — Veitch, *Man. Conif.* 97, f. 23, 24. — Kellogg, *Forest Trees of California*, 28. — Lauche, *Deutsche Dendr.* ed. 2, 83. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 212. — Mayr, *Wald. Nordam.* 334. — Lemmon, *Rep. California State Board Forestry*, iii. 146 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 63; *Bull. Sierra Club*, ii. 164 (*Conifers of the Pacific Slope*).

Pinus grandis, Hooker, *Fl. Bor.-Am.* ii. 163 (not D. Don) (1839). — Antoine, *Conif.* 63, t. 25, f. 1. — Hooker & Arnott, *Bot. Voy. Beechey*, 394. — Endlicher, *Syn. Conif.* 105. — Lawson & Son, *List No. 10, Abietineæ*, 12. — Dietrich, *Syn.* v. 394. — Courtin, *Fam. Conif.* 57. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 427 (excl. syn.). — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 678, t. 46, f. 4, 4 a. — Beissner, *Handb. Nadelh.* 476, f. 132. — Hansen, *Jour. R. Hort. Soc.* xiv. 467 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 16.

? **Abies aromatica**, Rafinesque, *Atlant. Jour.* 119 (Autumn, 1832); *New Fl.* i. 38. — Endlicher, *Syn. Conif.* 125. — Carrière, *Traité Conif.* 266.

Picea grandis, Loudon, *Arb. Brit.* iv. 2341, f. 2245, 2246 (in part) (1838). — Knight, *Syn. Conif.* 39. — Gordon, *Pinetum*, 155; Suppl. 52 (excl. syn. *Picea Parsonsii*). — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 46, 90 (in part), f. 16, t. 6. — A. Murray, *Gard. Chron.* n. ser. iv. 135, f. 28, 194, f. 40, 42.

Abies amabilis, A. Murray, *Proc. R. Hort. Soc.* iii. 310, f. 3–9; 321, f. 40 (not Forbes) (1863); *Gartenflora*, xiii. 118.

Abies Gordoniana, Carrière, *Traité Conif.* ed. 2, 298 (excl. syn. *Abies Parsonsii*) (1867). — Sénéclauze, *Conif.* 9. — Bertrand, *Bull. Soc. Bot. France*, xviii. 379; *Ann. Sci. Nat.* sér. 5, xx. 95.

Abies grandis, α Oregona, Beissner, *Handb. Conif.* 71 (1887).

Abies concolor, Leiberg, *Contrib. U. S. Nat. Herb.* v. 48 (not Lindley & Gordon) (1897).

A tree, in the neighborhood of the coast from two hundred and fifty to three hundred feet in height, with a slightly tapering trunk often four feet in diameter, and spreading somewhat pendulous branches which sweep out in long graceful curves, and on the mountains of the interior rarely more than one hundred feet tall, with a trunk usually about two feet thick, or frequently smaller and much stunted. The bark of the trunk, which on young trees is smooth, thin, and pale, and is marked with conspicuous resin blisters, becomes sometimes two inches in thickness at the base of old trees, on which it is dull gray-brown or reddish brown, and divided by shallow fissures into low flat ridges, broken into oblong plates and roughened by thick closely appressed scales. The winter-buds are globose, very resinous, from an eighth to a quarter of an inch thick, and covered by thin pale reddish brown scales, those of the inner ranks being united into cup-like covers deciduous in one piece from the branchlets. These are comparatively slender, puberulous during their first year, pale yellow-green when they first appear, and, becoming light reddish brown or orange-brown in their second season, gradually grow darker. The leaves are thin and flexible, deeply grooved and very dark green and lustrous on the upper surface and silvery white on the lower surface, with two broad bands each of from seven to ten rows of stomata, and hypoderm cells scattered in an interrupted layer under the epidermis of the upper side and only slightly developed on the edges and keels; on sterile branches the leaves are rather remote, rounded and conspicuously emarginate at the apex, from an inch and a half to two inches and a quarter long and usually about an eighth of an inch wide, and spread in two ranks nearly at right angles to the branchlet; on cone-bearing branches they are rather more crowded, generally from an inch to an inch and a half in length, less spreading or often nearly erect, and bluntly pointed and often notched at the apex; on the leading shoots of vigorous young trees they are from one half to three quarters of an inch long and acute or acuminate at the apex, which is furnished with a sharp rigid callous tip. The staminate flowers are oblong-cylindrical, and from one half to two thirds of an inch in length, with pale yellow anthers sometimes tinged with purple when they first emerge from the bud, and at maturity hang on slender pedicels one third of an inch long. The pistillate flowers are cylindrical, slender, from three quarters of an inch to an inch long, a quarter of an inch thick, and light yellow-green, with semi-orbicular scales and short oblong bracts, emarginate and denticulate or laciniate at the broad obcordate apex, which is furnished with a short strongly reflexed tip. The cones are cylindrical, slightly narrowed to the rounded and sometimes retuse apex, puberulous, bright green, from two to four inches in length, and from an inch to an inch and a quarter in thickness, with scales which are usually about two thirds as long as they are wide, and are gradually or abruptly narrowed from their broad apex, and three or four times as long as their short pale green bracts, which are only slightly contracted below the obcordate irregularly serrate apex, which is furnished with a short mucro. The seeds are three eighths of an inch long, light brown, with pale lustrous wings from one half to five eighths of an inch in length and nearly as broad at their abruptly widened rounded end as they are long.

One of the most distinct of the American Fir-trees in its widely spreading elongated dark green emarginate leaves, and in its green cones with included bracts, *Abies grandis* attains its greatest size on the alluvial bottom-lands of streams near the coast of southern British Columbia and of Washington, Oregon, and northern California. It is distributed from the northern part of Vancouver Island[1] southward to Mendocino County, California,[2] and eastward along the mountains of northern Washington and Idaho to the western slopes of the continental divide in northern Montana, and southward in the interior along both slopes of the Cascade Mountains[3] and to the Blue Mountains of Washington and Oregon, the Powder River Mountains of Oregon, and to the Cœur d'Alene and Bitter Root Mountains of Idaho and Montana. The White Fir does not grow gregariously; northward near the sea it is scattered always on moist ground through the forests of Douglas Spruces and Hemlocks, and on the bottom-lands of streams with the Tideland Spruce and the Arbor Vitæ; in California, where it does not range inland many miles or beyond the direct influence of the fogs of the Pacific, its companions are the Redwood, which with long naked stems it often rivals in height, and the Tideland Spruce. It is common in Washington and northern Oregon from the sea up to elevations of four thousand feet above it on the western slopes of the Cascade Mountains; it is less abundant on their eastern slopes, but farther east is a common tree in forests of Spruces, White Pines, Hemlocks, and Arbor Vitæs, on moist slopes, and in the neighborhood of streams from elevations of two thousand five hundred up to seven thousand feet above the sea-level.

The wood of *Abies grandis* is very light, soft, coarse-grained, and neither strong nor durable; it is light brown, with thin lighter colored sapwood, and contains broad dark-colored resinous conspicuous bands of small summer cells and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.3545, a cubic foot weighing 22.09 pounds. Occasionally manufactured into lumber in western Washington and Oregon, it is used for the interior finish of buildings, for packing-cases, and in cooperage.

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[1] G. M. Dawson, *Can. Nat.* n. ser. ix. 326. — Macoun, *Cat. Can. Pl.* 474.

[2] *Abies grandis* is abundant and of large size on the banks of the Navarro River in Mendocino County from the seacoast for a distance of about twelve miles inland (*teste* Carl Purdy). This is the most southern point on the coast of California at which I have heard of this tree.

[3] The southern limits of the range of *Abies grandis* on the Cascade Mountains of Oregon are still uncertain, as it is not always easy to distinguish this tree by the meagre specimens usually preserved in herbaria from the nearly related *Abies concolor*, which replaces it in the interior of southern Oregon. It appears, however, to extend along their western slopes to at least as far south as the head-waters of the Umqua River, and along their eastern slope to Mt. Jefferson. Between Ashland on the west and Upper Klamath Lake on the east of the mountains, the White Fir is always *Abies concolor*, which also replaces *Abies grandis* in the interior of California.

Abies grandis was probably one of the Pine-trees which Lewis and Clark saw in September, 1805, as they crossed the Bitter Root Mountains on their journey to the west.[1] Introduced into English gardens in 1831 by David Douglas, who found it near the mouth of the Columbia River, it has since been occasionally cultivated in the parks and gardens of Europe, where it grows rapidly,[2] and gives some promise of attaining the magnificent proportions and luxuriant growth which make this tree one of the stateliest and most splendid inhabitants of the forests of the northern hemisphere.[3]

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[1] *The History of the Expedition under Command of Lewis and Clark*, ed. Coues, ii. 598. See, also, Sargent, *Garden and Forest*, x. 99.

Among the trees of large growth described by Lewis and Clark (*l. c.* iii. 831) the third species was said to resemble in all parts the Canada Balsam Fir, its trunk being described as from two and a half to four feet in diameter, and its height at from eighty to one hundred feet. This description might be supposed to refer to *Abies grandis*, which is the only Fir-tree that grows in the neighborhood of the camp at the mouth of the Columbia River, where Lewis and Clark passed the winter, and where they had their best opportunities for the examination of trees; but the leaves were said to be only one eighth of an inch long and one sixteenth of an inch wide. Dr. Coues, acknowledging the uncertainty of the determination, suggested that this tree might be *Thuya gigantea.* The authors of the journal state that "this tree affords, in considerable quantities, a fine deeply aromatic balsam, resembling the balsam of Canada in taste and appearance. The small pistils, filled, rise like a blister on the trunk and the branches. The bark that envelops these pistils is soft and easily punctured; the general appearance of the bark is dark and smooth, but not so remarkable for that quality as the white pine of our country. The wood is white and soft." This description evidently refers to some species of Fir. The statement that the leaves were only an eighth of an inch long may have been the result of a clerical error. But the travelers may have confounded *Abies lasiocarpa*, which they must have seen in crossing the Bitter Root Mountains, and probably also on the continental divide, with the coast species, and certainly it is not safe to accept Rafinesque's name of *Abies aromatica*, based entirely on the description of Lewis and Clark's third species, for the White Fir of the coast, although it is a year earlier than Lindley's *Abies grandis*.

[2] *Abies grandis* is described as growing in Belgium sometimes at the rate of forty inches in height a year (see Wesmael, *Garden and Forest*, iii. 494); and in Mr. Schober's Pinetum in Putten, Holland, *Abies grandis* has surpassed all other conifers in rapidity of growth, a tree which in 1878 had a trunk circumference of twenty-two inches and a height of twenty-one feet four inches, having in 1886 a trunk circumference of forty-four inches and a height of thirty-five feet three inches, and in 1892 a trunk circumference of sixty-nine inches and a height of fifty feet. (See Schober, *Tijd. Nederl. Maatsch. Bevord. Nijver.* September, 1892 [*Pinetum Schoberianum*]. The tallest tree of this species reported in Great Britain in 1892 was at Riccarton, Midlothian, and was eighty-three feet three inches in height with a trunk three feet eight and one half inches in diameter. This tree is said to have grown fifty-three feet in twelve years, or an average of four feet five inches annually. Several other specimens in Great Britain were from sixty to seventy feet tall in 1892. [See Dunn, *Jour. R. Hort. Soc.* xiv. 82. See, also, Webster, *Gard. Chron.* n. ser. xxiii. 670.])

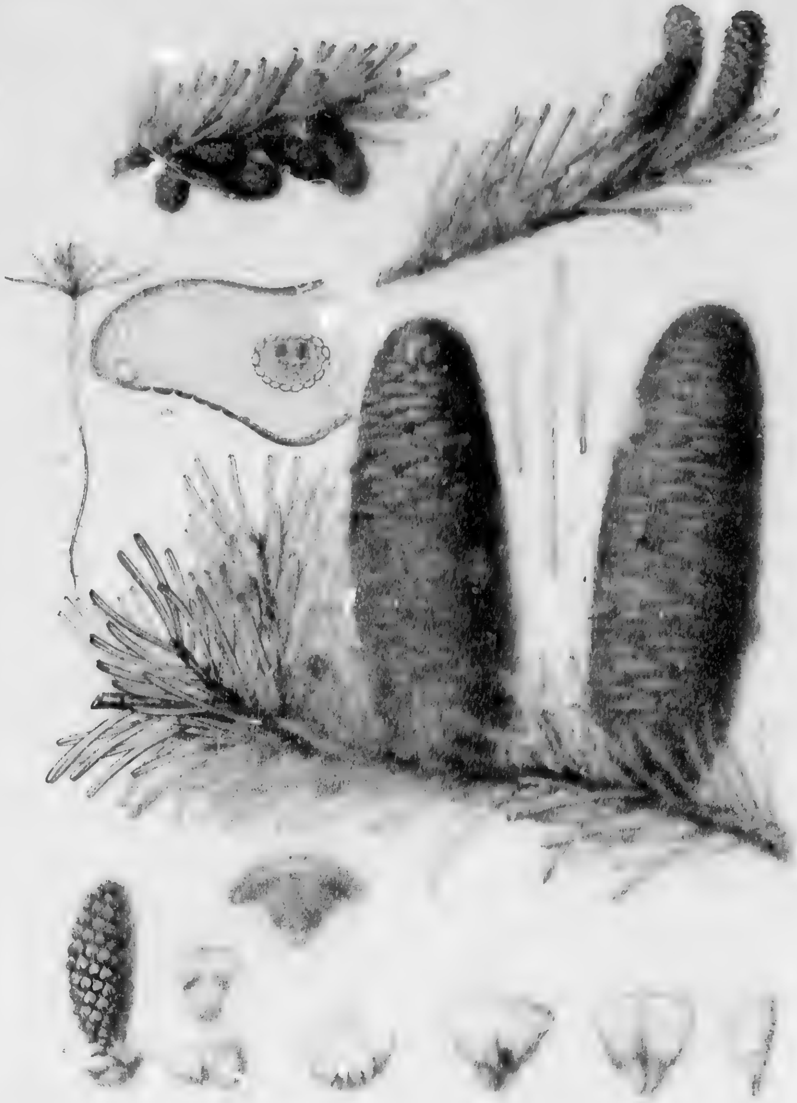
In the Arnold Arboretum plants of *Abies grandis*, obtained in 1880 by Mr. Sereno Watson in northern Idaho, have been kept alive in sheltered positions, but it is not probable that trees of this species, to which constant root moisture seems essential, can have a long life on the Atlantic seaboard.

[3] The log specimen of *Abies grandis*, cut near Portland, Oregon, in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, is twenty-four and one half inches in diameter inside the bark and one hundred and twenty-eight years old, with an inch and one eighth of sapwood showing twenty-one layers of annual growth.

EXPLANATION OF THE PLATE.

PLATE DCXII. ABIES GRANDIS.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, seen from below, enlarged.
4. An anther, side view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, lower side, with its bract, natural size.
10. A cone-scale, upper side, with its seeds, natural size.
11. A seed, natural size.
12. A leaf of a fertile branch, natural size.
13. A leaf of a sterile branch, natural size.
14. A leaf from the leader of a young tree, natural size.
15. Cross section of a leaf magnified fifteen diameters.
16. A seedling plant, natural size.

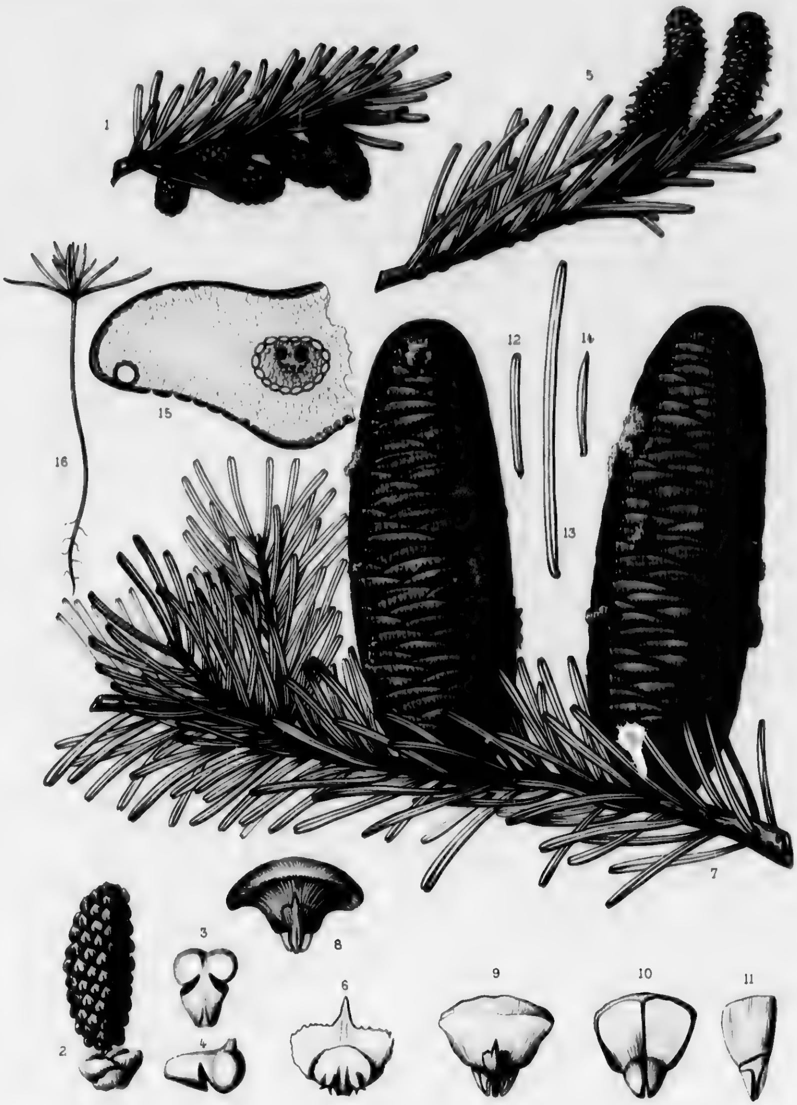


[illegible]

[illegible] THE PLATE

[illegible]

1. [illegible] staminate flowers, natural size.
2. [illegible] enlarged.
3. An [illegible] enlarged.
4. [illegible] enlarged.
5. [illegible] pistillate flowers, natural size.
6. A scale of a pistillate flower, upper side, with [illegible] and ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size
9. A cone-scale, lower side, with its bract, natural size.
10. A cone-scale, upper side, with its seeds, natural size.
11. A seed, natural size.
12. A leaf of a fertile branch, natural size.
13. A leaf of a sterile branch, natural size.
14. A leaf from the leader of a young tree, natural size.
15. Cross section of a leaf magnified fifteen diameters.
16. A seedling plant, natural size.



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ABIES GRANDIS, Lindl.

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ABIES CONCOLOR.

White Fir.

Bracts of the cone-scales oblong, emarginate or nearly truncate at the broad denticulate short-pointed apex. Leaves pale blue or glaucous, stomatiferous on the upper surface, rounded, acute, or acuminate at the apex, on fertile branches often falcate, and thickened and keeled above.

Abies concolor, Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 210 (1850). — Engelmann, *Trans. St. Louis Acad.* iii. 600; *Rothrock Wheeler's Rep.* vi. 255; *Gard. Chron.* n. ser. xii. 684, f. 114, 115; *Brewer & Watson Bot. Cal.* ii. 118. — Masters, *Gard. Chron.* n. ser. xiii. 648, f. 109, 110, xv. 660, f. 119; ser. 3, viii. 748, f. 147–151; *Jour. Linn. Soc.* xxii. 177, f. 8–11; *Jour. R. Hort. Soc.* xiv. 191. — Veitch, *Man. Conif.* 93. — Kellogg, *Forest Trees of California*, 31. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 212; *Gard. Chron.* n. ser. xxv. 20. — Coulter, *Man. Rocky Mt. Bot.* 430. — Mayr, *Wald. Nordam.* 334. — Beissner, *Handb. Nadelh.* 470, f. 129, 130. — Merriam, *North American Fauna*, No. 7, 340 (*Death Valley Exped.* ii.). — Hansen, *Jour. R. Hort. Soc.* xiv. 465 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 16. — Coville, *Contrib. U. S. Nat. Herb.* iv. 224 (*Bot. Death Valley Exped.*). — Lemmon, *West-American Cone-Bearers*, 64; *Bull. Sierra Club*, ii. 167 (*Conifers of the Pacific Slope*).

Abies balsamea, J. M. Bigelow, *Pacific R. R. Rep.* iv. pt. v. 18 (in part) (not Miller) (1856). — Torrey, *Pacific R. R. Rep.* iv. pt. v. 141 (in part).

Picea grandis, Newberry, *Pacific R. R. Rep.* vi. pt. iii. 46, 90 (in part) (not Loudon) (1857).

Picea concolor, Gordon, *Pinetum*, 155 (1858). — Syme, *Gard. Chron.* n. ser. iii. 563. — A. Murray, *Gard. Chron.* n. ser. iv. 135, f. 261; 194, f. 38, 41.

Picea Lowiana, Gordon, *Pinetum*, Suppl. 53 (1862).

Abies Lowiana, A. Murray, *Proc. R. Hort. Soc.* iii. 317, f. 21–24 (1863); *Gartenflora*, xiii. 118. — Lemmon, *Rep. California State Board Forestry*, iii. 148, t. 15, 16 (*Cone-Bearers of California*); *Bull. Sierra Club*, ii. 164 (*Conifers of the Pacific Slope*). — Masters, *Jour. R. Hort. Soc.* xiv. 192.

Abies grandis, Carrière, *Traité Conif.* ed. 2, 296 (not Lindley) (1867). — Bertrand, *Bull. Soc. Bot. France*, xviii. 378; *Ann. Sci. Nat.* sér. 5, xx. 94 (excl. syn.).

Pinus concolor, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 426 (1868). — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 681, t. 46, f. 6.

Picea Lowii, Fowler, *Gard. Chron.* 1872, 394.

Abies grandis, var. **concolor**, A. Murray, *Gard. Chron.* n. ser. iii. 105 (1875).

Picea concolor, var. **violacea**, A. Murray, *Gard. Chron.* n. ser. iii. 464, f. 94, 95 (1875).

Pinus Lowiana, W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 680, t. 46, f. 5 (1877).

Abies lasiocarpa, Masters, *Gard. Chron.* n. ser. xiii. 8, f. 1 (not Nuttall nor A. Murray) (1880).

Abies grandis, var. **Lowiana**, Masters, *Jour. Linn. Soc.* xxii. 175, f. 6, 7 (1887).

Abies concolor, var. **lasiocarpa**, Beissner, *Handb. Conif.* 71 (not *Abies lasiocarpa*, Nutt.) (1887); *Handb. Nadelh.* 473.

Abies concolor, var. **Lowiana**, Lemmon, *West-American Cone-Bearers*, 64 (1895).

A tree, on the Sierra Nevada of California from two hundred to two hundred and fifty feet in height, with a trunk often six feet in diameter, but in the interior of the continent rarely more than one hundred and twenty-five feet tall, with a trunk which seldom exceeds three feet in diameter. On young trees, which are very symmetrical, the bark of the tapering stem is thin, smooth, and pale gray-brown, and the comparatively short stout branches, disposed in regular remote whorls, stand out horizontally, and, furnished with long lateral branchlets which point forward, form great flat-topped frond-like masses of foliage; on large trees, which are occasionally three hundred years old, the bark of the trunk becomes five or six inches thick near the ground, and is deeply divided into broad rounded ridges broken on the surface into irregularly shaped plate-like scales which below are dull reddish brown in color and above are ashy gray, the inner bark being dull orange-color, and the tall massive stems, often naked for one hundred feet, are surmounted by narrow spire-like crowns of short branches spreading near the very top of the tree and pendulous below. The winter-buds are nearly globose, from one eighth to one quarter of an inch thick, very resinous and covered by orange-brown scales, those of the inner ranks being united into a cup-like cover on the lengthening branchlet and falling in one piece. The branchlets are glabrous, lustrous, and comparatively stout; during their first season they are dark orange-color, and, becoming light grayish green or pale reddish brown during their second season, they gradually turn gray or grayish brown. The leaves are crowded, distichously spreading, and more or less erect even on the lower branches of young trees from the strong twisting of their base, and are pale blue or glaucous, becoming dull green at the end of two or three years, marked on the lower surface by two broad bands each of from six to eight rows of stomata, and more or less stomatiferous on the upper surface, their hypoderm cells forming an interrupted layer under the epidermis on the upper side; on lower branches they are flat, straight, rounded, acute, or acuminate at the apex, from two to three inches in length and about a sixteenth of an inch wide, and on fertile branches and on old trees they are frequently thick, keeled on the upper surface, usually falcate, acute or rarely notched at the apex, from three quarters of an inch to an inch and a half long and often fully an eighth of an inch wide.[1] The staminate flowers are oblong-cylindrical and from one half to three quarters of an inch long, with dark red or rose-colored anthers which turn yellow in fading; the pistillate flowers are cylindrical, and from an inch and a quarter to an inch and a half long, with broad rounded scales and oblong strongly reflexed oblong-obcordate bracts laciniate above the middle and abruptly contracted at the apex into short points. The cones are oblong, slightly narrowed from near the middle to the ends, and rounded and retuse at the apex, from three to five inches long, from an inch and one quarter to an inch and three quarters thick, puberulous, and grayish green, dark purple,[2] or bright canary-yellow, with scales which are much broader than they are long, gradually and regularly narrowed at the denticulate sides from the rounded apex, and rather more than twice the length of their bracts; these are oblong, emarginate or nearly truncate and denticulate at the broad apex, which terminates in a short slender mucro. The seeds are from one third to nearly one half of an inch in length, very acute at the base and dark dull brown, with lustrous bright rose-colored wings which are widest near the middle, about one third longer than they are broad, and nearly truncate at the apex.

Of the Fir-trees of North America, *Abies concolor* best endures heat and dryness, and it is able to grow on arid mountain slopes where few other trees can maintain a foothold. Its northern home is on the Cascade Mountains of southern Oregon.[3] It is common on the Siskiyou and other cross ranges of southern Oregon and northern California, and on the high peaks of the California coast ranges.[1] With *Abies magnifica* it forms almost exclusively one of the principal forest belts on the western slopes of the Sierra Nevada four hundred and fifty miles long and in breadth extending from five thousand up to nearly nine thousand feet above the level of the sea.[2] It is abundant on all the cross ranges that divide the San Joaquin Valley from southern California, and on the San Bernardino and San Jacinto Mountains between elevations of four and eight thousand feet above the sea,[3] and finds its most southerly home on the Pacific coast on Mt. San Pedro Martir in Lower California.[4] In Oregon, east of the Cascade Mountains, it occurs at an elevation of seven thousand seven hundred feet on the high mountains on the east side of Warner Lake with *Pinus ponderosa*, and on the Warner Range.[5] It is common at high elevations on the east slope of the Sierra Nevada, on the high desert ranges of the Great Basin, and in the cañons and on the slopes of the high mountains of Utah and western Colorado; on the outer ranges of the Rocky Mountains east of the continental divide, it is found only south of the heights which separate the waters of the Platte from those of the Arkansas River, sometimes ascending to elevations of eleven thousand feet above the sea, and southward often forming a large part of extensive forests. It is common, too, on the mountains of northern New Mexico and Arizona[6] up to elevations of six thousand feet above the sea-level, but it is less abundant on the mountains on both sides of the boundary between New Mexico and Arizona and Mexico, where it usually grows only in the bottoms of elevated cañons.

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[1] The leaves of *Abies concolor* are usually rounded and only exceptionally notched at the apex, but in dry regions they are often acute or acuminate, and are sometimes furnished with stiff callous tips. In California, on the San Rafael Mountains, some of the leaves of this tree are acute; on the San Bernardino Mountains fertile branches bear acute leaves nearly an inch and a half long, terminating in long callous tips, and such leaves are also produced on trees growing on the San Francisco Peaks of Arizona, and on the Huachuca Mountains of southern Arizona, and near Santa Fé in New Mexico. On the upper slopes of the southern rim of the Grand Cañon of the Colorado in Arizona, *Abies concolor* sometimes produces very flat thin strongly falcate leaves gradually narrowed into slender callous-tipped points; and on San Pedro Martir, in Lower California, its leaves are very thick and rigid, with prominent midribs on the upper side, strongly falcate, acute or acuminate, with callous tips, from an inch to an inch and a half long and rather more than an eighth of an inch wide. In Colorado and New Mexico the leaves, especially on young trees, are usually but not always of a more glaucous color than farther westward, but the color of the leaves can hardly be relied on to separate specifically the tree of the California Sierras from that of the interior any more than the length of the leaves and the form of their apex can be depended on to furnish constant specific characters, as English botanists have sometimes believed, for the separation of this White Fir into two species. Although trees east of the Sierra Nevada usually bear longer and more pointed leaves than those which grow on the western slope of the Sierras (the *Abies Lowiana* of English gardens, see Masters, *Gard. Chron.* n. ser. xxvi. 755, f. 146–148), I have gathered specimens in Strawberry Valley, in northern California, with acute leaves, and such leaves may be found all through the Sierras, while in Colorado and New Mexico trees with leaves obtusely rounded at the apex are common.

[2] Brandegee, *Bot. Gazette*, iii. 33.

[3] In southern Oregon *Abies concolor* is very abundant on low hills at elevations of between two and three thousand feet above the level of the sea. Although I have not seen it north of a line drawn from Ashford on the west to Upper Klamath Lake, on the east of the Cascade Mountains, *Abies concolor* will probably be found west of the Cascade Mountains as far north as the divide between the waters of the Umqua and Rogue Rivers, which, marking the southern limits of distribution of many northern plants and the northern limit of many from the south, is the real northern boundary of the region occupied by the California flora. Specimens gathered by Coville in 1897 at Fish Lake, which is one of

The wood of *Abies concolor* is very light, soft, coarse-grained, and not strong nor durable; it is very pale brown or sometimes nearly white, with narrow inconspicuous resinous bands of small summer cells and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.3638, a cubic foot weighing 22.67 pounds. It is occasionally manufactured into lumber, and in northern California is used for packing-cases and butter-tubs.

Abies concolor was discovered by August Fendler[7] near Sante Fé in 1847; in 1851 John

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the most northern tributaries of the Mackenzie, and separates the waters of that stream from those of the Santiam, can doubtfully be referred to this species. On the east side of the Cascade Mountains *Abies concolor* probably ranges at least as far north as the head-waters of the Mitelius River southeast of Mt. Jefferson.

[1] K. Brandegee, *Zoë*, iv. 176.

[2] Muir, *The Mountains of California*, 172, f.

[3] S. B. Parish, *Zoë*, iv. 352.

[4] Brandegee, *Zoë*, iv. 210.

[5] Merriam, *in litt.*

[6] Merriam, *North American Fauna*, No. 3, 120.

[7] August Fendler (January, 1813–1883), the son of a carver in wood and ivory, was born in Gumbinnin in eastern Prussia. Losing his father in infancy, he was sent to the town gymnasium when twelve years old, and at sixteen was apprenticed to the town clerk. Afterward he learned the trade of a tanner, believing that it would enable him to travel over Europe and America. In 1834 Fendler obtained a nomination to the Royal Polytechnic School in Berlin, but was obliged to abandon his studies at the end of the year on account of delicate health, and in 1834 sailed from Bremen for Baltimore, where he arrived with only two dollars in his pocket. For ten years Fendler wandered over the eastern states, maintaining himself by working in tanneries or lamp factories and by teaching school.

Returning to Prussia in 1844, he made the acquaintance at Königsberg of Dr. Ernst Meyer, the botanist, who showed him the way to his career of usefulness by pointing out the fact that he could support himself by collecting for sale herbaria of the plants of the western United States. Returning to St. Louis, where he had previously lived for some time, he began collecting plants with the advice and assistance of Dr. Engelmann. In 1847 an opportunity was obtained for him to accompany the United States troops, which during the Mexican War took possession of Santa Fé; here he remained during a year, and, after Wislizenus, was the first botanist to investigate the flora of the southern Rocky Mountains. Returning from Mexico, Fendler undertook a botanical journey to the region of Salt Lake, but lost his outfit before he reached the Rocky Mountains, and was obliged to go back to St. Louis, where he found that all his possessions had been destroyed in a great fire which had devastated the city. He next visited the Isthmus of Panama, making collections in the neighborhood of Chagres, and then, returning to the United States, established himself at Memphis, where for three years he carried on the camphine light business. This became unprofitable owing to the introduction of coal gas, and in 1854, craving new scenes, Fendler sailed for Venezuela, where at Colonia Tovar, at an elevation of six thousand feet above the sea, he remained for five or six years, making large collections of plants which now have a place in the principal herbaria of the United States and Europe. Returning to Missouri in 1864, Fendler cleared in the forest a farm for himself near Allenton. Here he lived for seven years, and then, selling his farm, returned to Prussia with the intention of remaining there. His love of the United States, however, brought him again across the Atlantic, and in 1876 he settled in Delaware, where he devoted himself to botany, meteorology, to which he had always paid much attention, and to speculative physics, publishing at this time a book entitled, *The Mechanics of the Universe*. Repeated attacks of acute rheumatism compelled him to seek a warm climate again, and in 1877 Fendler landed at Port of Spain, in the island of Trinidad, where he passed the remainder of his days, living mainly on the

Jeffrey[1] found it on the mountains of northern California, but for many years his specimen was believed to have been gathered from a tree of *Abies lasiocarpa*, and it was not until 1873 that Engelmann was able to make known the true characters and the distribution of *Abies concolor*. Introduced into England by Jeffrey and by Lobb in 1852, it has proved one of the handsomest and most satisfactory of garden conifers from southern Scandinavia to northern Italy.[2] On the Atlantic seaboard it is hardy as far north, at least, as the coast of Maine; and *Abies concolor* from the Rocky Mountains growing here during the last twenty-five years always vigorously, compact in habit, beautiful in its varied shades of blue, and free from diseases and the attacks of disfiguring insects, is now more full of promise as an ornament of the parks of eastern America than any other Fir-tree.[3]

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produce of a small piece of ground which he had bought, but maintaining his activity as a botanical collector.

Many of the plants collected by Fendler in New Mexico were published by Asa Gray in the fourth volume of the new series of the *Memoirs of the American Academy of Arts and Sciences*, in a classical paper entitled *Plantæ Fendlerianæ Novi-Mexicanæ*. The name of this honest, kindly, simple, earnest man is preserved in our gardens in *Fendlera*, a beautiful-flowered shrub of the Saxifrage family, of Texas and New Mexico. (See Gray, *Am. Jour. Sci.* ser. 3, xxiv. 169. — Canby, *Bot. Gazette*, x. 285, 301 [*An Autobiography and some Reminiscences of the late August Fendler*].)

[1] See xi. 41.

[2] Under the names of *Abies concolor violacea* and *Abies violacea*, the bluest leaved forms of the Rocky Mountain tree are found in European collections. A seedling form with erect branches (*Abies concolor fastigiata*, Carrière, *Rev. Hort.* 1890, 137) appeared in France a few years ago in the nursery of Thibault & Keteleer at Sceaux, near Paris.

[3] In the eastern states *Abies concolor* from Colorado is the only American Fir-tree which is really satisfactory in cultivation. There are a number of specimens of the California tree in different gardens from eastern Massachusetts to Pennsylvania. (See Parsons, *Gardener's Monthly*, xvii. 369 [as *Picea Parsonsiana*]. — Sargent, *Garden and Forest*, vi. 458.) These appear as hardy as the plants raised from seeds gathered in Colorado, but they grow with less vigor and rapidity, and the largest of them, which are from forty to fifty feet tall, are already thin near the ground, and have passed the period of their greatest beauty.

EXPLANATION OF THE PLATE.

PLATE DCXIII. ABIES CONCOLOR.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A scale of a pistillate flower, lower side, with its bract and ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. A seed, natural size.
11. An end of a lateral branch, natural size.
12. Cross section of a leaf magnified fifteen diameters.
13. Winter-buds, natural size.

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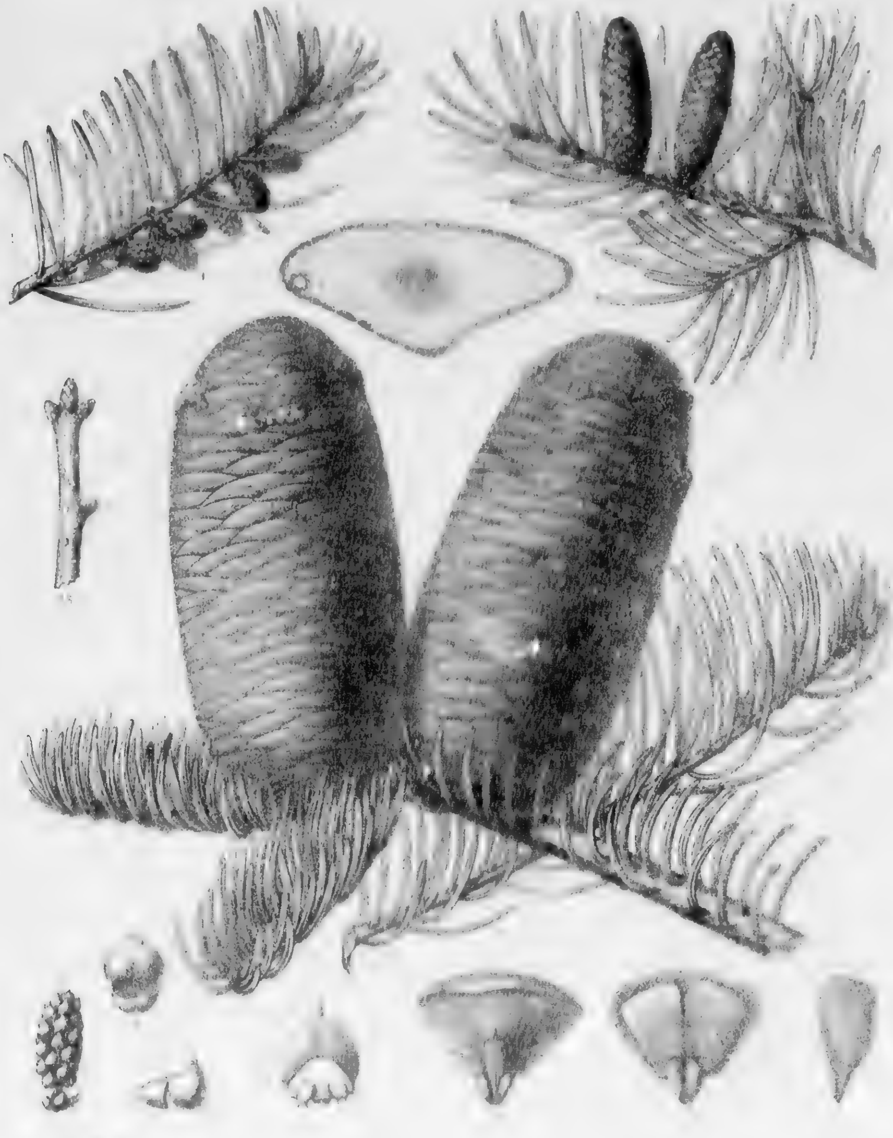

ABIES CONCOLOR.

[illegible] found it on the mountains of northern California, but for many years his specimen was supposed to have been gathered from a tree of *Abies lasiocarpa*, and it was not until 1873 that Engelmann was able to make known the true characters and the distribution of *Abies concolor*. Introduced into England by Jeffrey and by Lobb in 1852, it has proved one of the handsomest and most satisfactory of garden conifers from southern Scandinavia to northern Italy.[2] On the Atlantic seaboard it is hardy as far north, at least, as the coast of Maine; and *Abies concolor* from the Rocky Mountains growing here during the last twenty-five years always vigorously, compact in habit, beautiful in its varied shades of blue, and free from diseases and the attacks of disfiguring insects, is now more full of promise as an ornament of the parks of eastern America than any other Fir-tree.[3]

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produce of a small piece of ground which he had bought, but maintaining his activity as a botanical collector.

Many of the plants collected by Fendler in New Mexico were published by Asa Gray in the fourth volume of [illegible] the *Memoirs of the American Academy of Arts and Sciences*, in a classical paper entitled *Plantæ Fendlerianæ Novi-Mexicanæ*. The name [illegible] *Fendler*!.)

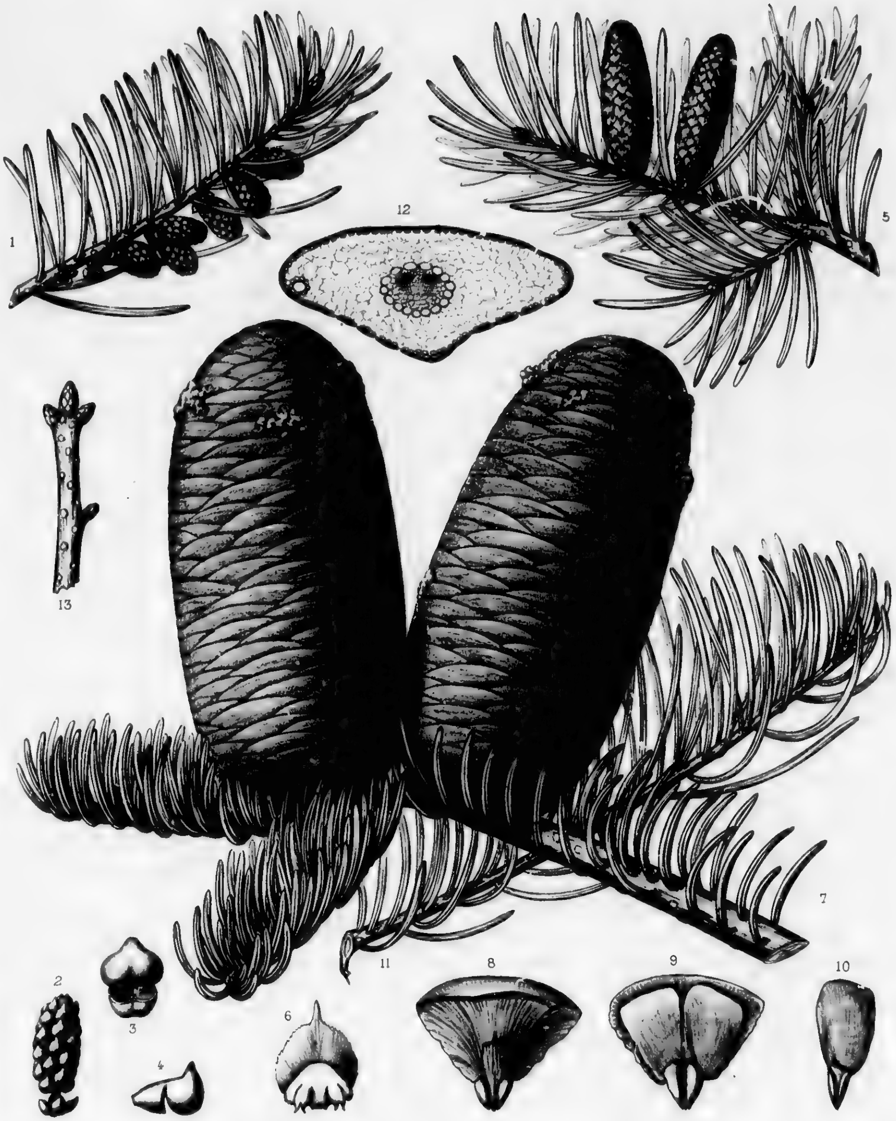
[2] [illegible] *Abies concolor violacea* and *Abies violacea*, [illegible] European collections. A seedling form with erect branches (*Abies concolor fastigiata*, Carrière, *Rev. Hort.* 1890, 137) appeared in France a few years ago in the nursery of Thibault & Keteleer [illegible]

[3] [illegible] *Abies concolor* from Colorado is the only [illegible] really satisfactory in cultivation. There [illegible] California tree in different [illegible] Pennsylvania. (See Parsons [illegible] *Picea Parsonsiana*]. — Sargent [illegible] appear as hardy as the plants raised from seeds gathered in Colorado, but they grow with less vigor and rapidity, and the largest of them, which are from forty to fifty feet tall, are already thin near the ground, and have passed [illegible]

EXPLANATION OF THE PLATE.

PLATE DCXIII. ABIES CONCOLOR.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, front view, enlarged.
4. An anther, side view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A scale of a pistillate flower, lower side, with its bract and ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds, natural size.
10. A seed, natural size.
11. An end of a lateral branch, natural size.
12. Cross section of a leaf magnified fifteen diameters.
13. Winter-buds, natural size.



C. E. Faxon del. Rapine sc.

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ABIES AMABILIS.

White Fir.

Bracts of the cone-scales rhombic or oblong-obovate, gradually narrowed into long slender tips, half as long as their scales. Leaves dark green and very lustrous above, silvery white below, rounded, notched, or acute, or on fertile branches acuminate and occasionally stomatiferous on the upper surface.

Abies amabilis, Forbes, *Pinetum Woburn.* 125, t. 44 (1839). — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 210. — Carrière, *Traité Conif.* 219. — Lyall, *Jour. Linn. Soc.* vii. 143. — Henkel & Hochstetter, *Syn. Nadelh.* 159. — Sénéclauze, *Conif.* 5. — Hoopes, *Evergreens*, 209 (excl. syn. *Abies lasiocarpa*). — K. Koch, *Dendr.* ii. pt. ii. 211 (excl. syn. *Abies lasiocarpa*). — Engelmann, *Gard. Chron.* n. ser. xiv. 720, f. 136–146; *Bot. Gazette*, vii. 4. — Veitch, *Man. Conif.* 86. — Lauche, *Deutsche Dendr.* ed. 2, 83. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 213. — Masters, *Jour. Linn. Soc.* xxii. 171, f. 1–3, t. 2; *Gard. Chron.* ser. 3, iii. 754, f. 102; *Jour. R. Hort. Soc.* xiv. 189. — Mayr, *Wald. Nordam.* 351. — Lemmon, *Rep. California State Board Forestry*, iii. 139 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 61; *Bull. Sierra Club*, ii. 163, t. 24 (*Conifers of the Pacific Slope*). — Beissner, *Handb. Nadelh.* 466, f. 126. — Hansen, *Jour. R. Hort. Soc.* xiv. 455 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 16.

Pinus grandis, D. Don, *Lambert Pinus*, iii. t. (1837).

Picea amabilis, Loudon, *Arb. Brit.* iv. 2342 (in part), f. 2247, 2248 (1838). — Knight, *Syn. Conif.* 39. — Gordon, *Pinetum*, 154 (excl. syn. *Pinus lasiocarpa*); ed. 2, 213 (excl. syn.). — Newberry, *Pacific R. R. Rep.* vi. pt. ii. 51, f. 18. — (Nelson) Senilis, *Pinaceæ*, 36.

Picea grandis, Loudon, *Arb. Brit.* iv. 2341 (in part) (not *Abies grandis*, Lindley) (1838).

Pinus amabilis, Antoine, *Conif.* 63, t. 25, f. 2 (1840–47). — Hooker & Arnott, *Bot. Voy. Beechey*, 394. — Endlicher, *Syn. Conif.* 104. — Lawson & Son, *List No. 10, Abietineæ*, 11. — Dietrich, *Syn. Conif.* v. 394. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 426 (in part). — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 677, t. 46, f. 3, 3 a (excl. syn.).

Pinus lasiocarpa, A. Murray, *Rep. Oregon Exped.* 1, t. f. (*Picea* on plate) (not Hooker) (1853).

Abies grandis, A. Murray, *Proc. R. Hort. Soc.* iii. 308, f. 1–2 (not Lindley) (1863); *Gartenflora*, xiii. 118.

Abies lasiocarpa, A. Murray, *Proc. R. Hort. Soc.* iii. 314, f. 17 (1863).

Abies grandis, var. **densifolia**, Engelmann, *Trans. St. Louis Acad.* iii. 599 (1878).

A tree, often two hundred and fifty feet in height, or at high altitudes and in the north usually not more than seventy or eighty feet tall, with a trunk from four to six feet in diameter, in thick forests often naked for one hundred and fifty feet, or in open situations densely clothed to the ground with comparatively short branches sweeping down in graceful curves and furnished with elongated lateral pendulous branchlets. Until the tree is about one hundred and fifty years old, when, in favorable situations, it may be one hundred and twenty-five feet high, the bark of the trunk is thin, smooth, and pale or silvery white, and on old trees it becomes near the ground from an inch and a half to two inches and a half in thickness, and is irregularly divided into comparatively small plates covered with small closely appressed reddish brown or reddish gray scales. The winter branch-buds are nearly globose and from an eighth to a quarter of an inch in thickness, with closely imbricated dark lustrous purple scales thickly coated with resin. The branchlets are stout, clothed for four or five years with soft fine pubescence, light orange-brown during their first season, dark purple in their second, and ultimately become reddish brown. The leaves are flat, deeply grooved, and very dark green and lustrous on the upper surface and silvery white on the lower, with broad bands of about six rows of stomata occupying the space between the prominent midrib and the recurved margins, resin ducts close to the lower side and hypoderm cells forming an interrupted border under the epidermis on both surfaces and on the edges; on sterile branches they are obtuse and rounded and notched or occasionally acute at the apex, from three quarters of an inch to an inch and a quarter in length, from one sixteenth to one twelfth of an inch in width, often broadest above the middle, erect by a twist at their base and very crowded, those on the upper side of the branch being much shorter than those on the lower and usually parallel with and closely appressed against it; on fertile branchlets they are nearly erect, acute or acuminate, with callous tips, occasionally stomatiferous on the upper surface near the apex and from one half to three quarters of an inch in length; on vigorous leading shoots they are acute, with long rigid points, closely appressed or recurved near the middle, about three quarters of an inch long and nearly one eighth of an inch wide. The staminate flowers are oblong-cylindrical and from one half to three quarters of an inch in length, with strawberry-red anthers, and at maturity hang on slender pedicels from an eighth to nearly a quarter of an inch long. The pistillate flowers are oblong-cylindrical, from three quarters of an inch to an inch in length and about a third of an inch thick, with broad rounded purple scales and rhombic dark purple lustrous bracts erose above the middle and gradually contracted into broad points. The cones are oblong, slightly narrowed to the rounded and often retuse apex, deep rich purple, puberulous, from three and a half to nearly six inches in length and from two to two and a half inches in diameter, with scales from an inch to an inch and an eighth wide, nearly as long as they are broad, gradually narrowed from the rounded apex, and rather more than twice as long as their reddish rhombic or oblong-obovate bracts terminating in long slender tips. The seeds are light yellow-brown and half an inch long, with obliquely cuneate pale brown lustrous wings which are three quarters of an inch in length and somewhat less in breadth.[1]

Abies amabilis inhabits both slopes of the Cascade Mountains,[2] the coast ranges of Oregon[3] and Washington, and the mountains of southern British Columbia from Vancouver Island[4] to the valley of the lower Fraser River.[5] On the Cascade Mountains it extends from elevations of three thousand up to about six thousand feet or nearly to the timber-line, mingling below with *Tsuga heterophylla*, *Picea Engelmanni*, *Abies nobilis*, and *Abies grandis*, and above with *Pinus albicaulis*, *Tsuga Mertensiana*, and *Abies lasiocarpa*, and at high altitudes it often grows alone on the margins of alpine meadows singly or in small isolated groves. On the Olympic Mountains of northwestern Washington, where it probably attains its greatest size, *Abies amabilis* is the most common Fir-tree, occupying well-drained slopes and benches and less commonly the banks of streams at elevations of from twelve hundred feet up to the timber-line, which is here about four thousand five hundred feet above the sea, being most abundant and, with the Hemlock, forming a large part of the forest between elevations of three and four thousand feet. On the mainland of British Columbia, associated with *Tsuga heterophylla*, *Tsuga Mertensiana*, *Pinus albicaulis*, and *Pinus monticola*, it is common above the forests of Pseudotsuga at elevations of from four to five thousand five hundred feet above the sea.

The wood of *Abies amabilis* is light, hard, not strong, and close-grained; it is pale brown, with nearly white sapwood, and contains dark-colored resinous bands of small summer cells and numerous thin medullary rays. The specific gravity of the absolutely dry wood is 0.4228, a cubic foot weighing 26.35 pounds. Under the name of larch it is occasionally used in Washington in the interior finish of buildings.

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[1] On a ridge of the Olympic Mountains separating the waters of the Solduc from those of the Quillyhute, I found, on August 19, 1896, at an elevation of four thousand five hundred feet above the sea, an Abies from sixty to eighty feet in height, growing with *Abies lasiocarpa* and *Abies amabilis*, with the slender spire-like head and the foliage of the former and the cones of the latter. It was, perhaps, a natural hybrid between these species.

[2] *Abies amabilis* ranges nearly to the southern end of the Cascade Mountains of Oregon, the most southern tree seen by Dr. Coville, in 1897, being "on the eastern slope of Old Bailey Mountain, which lies on the west side of Diamond Lake about twenty miles north of Crater Lake. Proceeding northward from this point, we did not see the tree again until we reached the extreme southern head-waters of the Willamette River, about twelve miles north of Diamond Lake. Here on the northern slope of the Calapooia Mountains, close to their junction with the crest of the Cascades, the tree grew in great abundance on northern slopes." (Coville, *in litt.*)

[3] The most southern point at which *Abies amabilis* has been seen by Mr. A. J. Johnson of Astoria on the coast ranges is on Saddle Mountain, twenty-five miles south of the mouth of the Columbia River.

[4] In 1887 *Abies amabilis* was found on Vancouver Island by Mr. John Macoun, on the summits of Mounts Monk, Benson, and Arrowsmith, where it grows with *Tsuga Mertensiana*. (See Macoun, *Cat. Can. Pl.* iv. 336.)

[5] In July, 1880, *Abies amabilis* was first found in British Columbia by Engelmann, Parry and Sargent, on the high mountains south of Yale on the lower Fraser River.

The northern range of *Abies amabilis* is still to be determined. It grows so abundantly to a large size at high elevations on the mountains rising above the lower Fraser River valley that it may be supposed to extend much farther north along the coast ranges of British Columbia.

Abies amabilis was discovered on the Cascade Mountains just south of the Columbia River in September, 1825, by David Douglas, who introduced it into English gardens.[1]

Unsurpassed among Fir-trees in the beauty of its snowy bark, dark green lustrous foliage, and great purple cones, *Abies amabilis* can never be forgotten by those who have seen it at midsummer towering high above alpine meadows clothed with Lilies and great nodding Dogtooth Violets, Bryanthus and Cassiope, Rhododendrons, Lupins, Painted-cups, and all the other flowers which make the upper valleys of the northern Cascade Mountains the most charming natural gardens of the continent. When transferred from its mountain home *Abies amabilis* does not really flourish, although a few of the oldest specimens in Europe have produced cones.[2] On the Atlantic seaboard it grows very slowly and gives little promise of becoming an ornament of our gardens.[3]

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[1] Douglas, *Companion Bot. Mag.* ii. 93. See, also, Sargent, *Gard. Chron.* n. ser. xvi. 7.

[2] See Fowler, *Gard. Chron.* 1872, 286.

Very few plants having been raised from Douglas's seeds, *Abies amabilis* has always been rare in Europe until 1882, when large supplies of seeds were sent to England from Oregon.

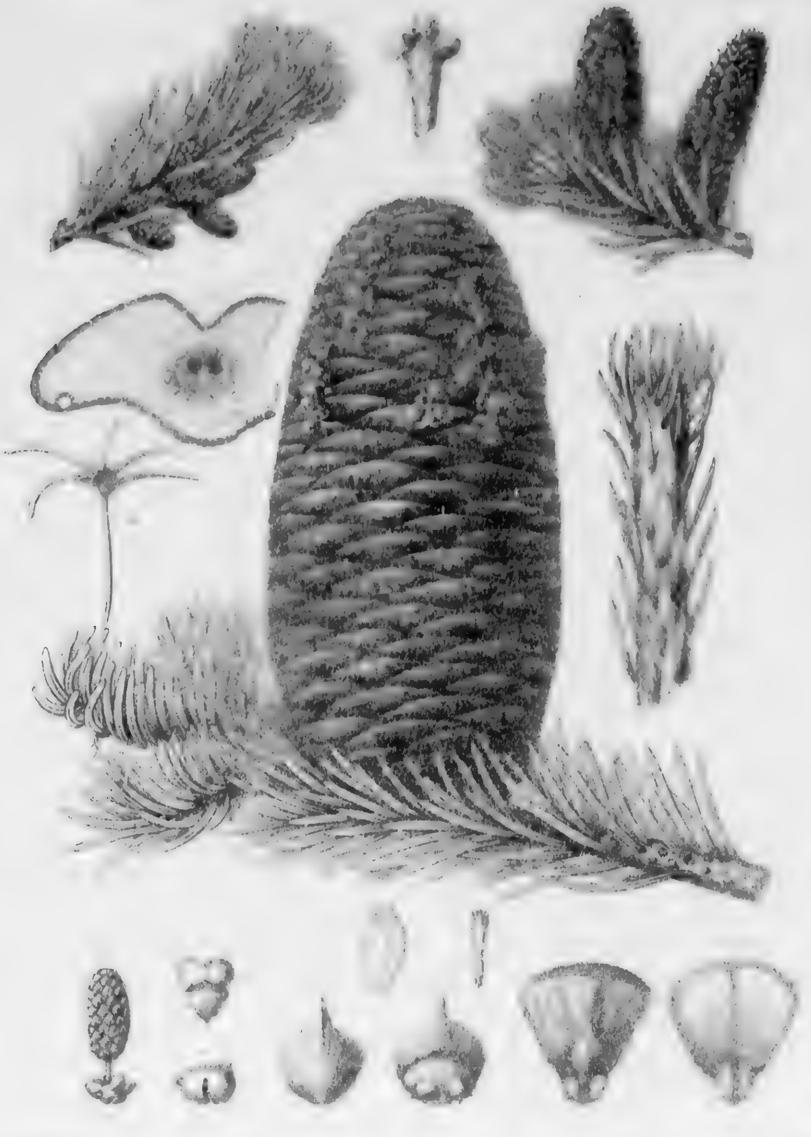
[3] Probably the oldest plant of *Abies amabilis* in the eastern United States is in the Pinetum of Mr. Josiah Hoopes of West Chester, Pennsylvania. It is a graft taken from the plant in the Edinburgh Botanic Garden raised from seeds collected by Douglas. It has grown very slowly, and in 1893, when it was about twenty-five years old, it was only six feet high. (See *Garden and Forest*, ii. 228; vi. 458.) In eastern Massachusetts, where *Abies amabilis* was introduced in 1880 through the Arnold Arboretum, it has proved rather tender and grows very slowly.

Even in its native forests *Abies amabilis* is a slow-growing tree. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut on the Cascade Mountains of Oregon, near the Columbia River, is seventeen and one half inches in diameter inside the bark and one hundred and eighty years old, with two and one eighth inches of sapwood containing seventy layers of annual growth. A tree cut in 1896, on the banks of the Soldue River, Washington, in a region of excessive rainfall specially favorable for the rapid growth of trees, was one hundred and twenty-five feet high, with a trunk nineteen inches in diameter, and one hundred and fifty years old.

EXPLANATION OF THE PLATE.

PLATE DCXIV. ABIES AMABILIS.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, seen from below, enlarged.
4. An anther, side view, enlarged.
5. A branch with pistillate flowers, natural size.
6. A bract of a pistillate flower, enlarged.
7. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, lower side, with its bract, natural size.
10. A cone-scale, upper side, with its seeds, natural size.
11. Vertical section of a seed, enlarged.
12. An embryo, enlarged.
13. The tip of a leading shoot, natural size.
14. Cross section of a leaf magnified fifteen diameters.
15. Winter-buds, natural size.
16. A seedling plant, natural size.



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EXPLANATION OF THE PLATE.

[illegible]

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, seen from below, enlarged.
4. An anther, side view, enlarged.
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6. A bract of a pistillate flower, enlarged.
7. A scale of a pistillate flower, upper side, with its [illegible] ovules, enlarged.
8. A fruiting branch, natural size.
9. A cone-scale, lower side, with its bract, natural size.
10. A cone-scale, upper side, with its seeds, natural size.
11. Vertical section of a seed, enlarged.
12. An embryo, enlarged.
13. The tip of a leading shoot, natural size.
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15. Winter-buds, natural size.
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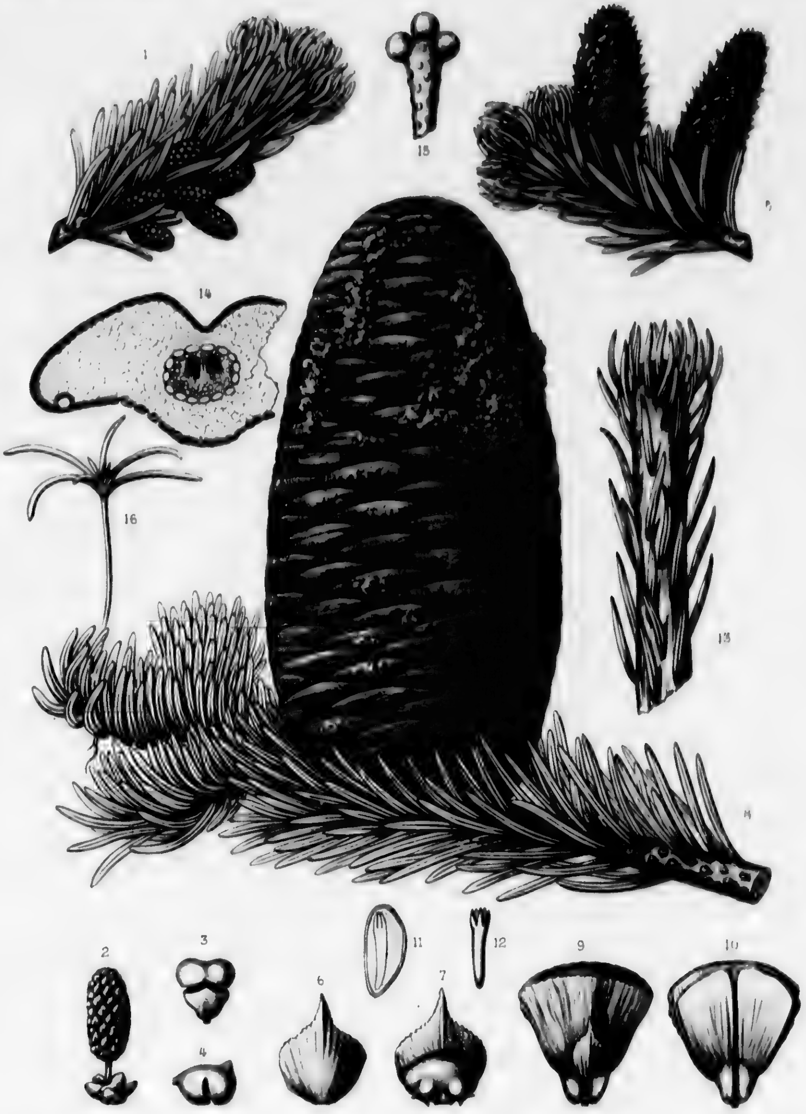

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ABIES AMABILIS, Forbes.

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ABIES VENUSTA.

Silver Fir.

Bracts of the cone-scales oblong-obovate, obcordate, furnished with elongated rigid flat tips many times longer than the pointed scales. Leaves acuminate, dark yellow-green and lustrous above, silvery white below. Winter-buds large, with thin loosely imbricated scales.

Abies venusta, K. Koch, *Dendr.* ii. pt. ii. 210 (1873). — Lauche, *Deutsche Dendr.* ed. 2, 82, f. 16. — Sargent, *Garden and Forest*, ii. 496. — Lemmon, *Rep. California State Board Forestry*, iii. 151 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 64; *Bull. Sierra Club*, ii. 166 (*Conifers of the Pacific Slope*).

Pinus venusta, Douglas, *Companion Bot. Mag.* ii. 152 (1836).

Pinus bracteata, D. Don, *Trans. Linn. Soc.* xvii. 442 (1837); *Lambert Pinus*, iii. t. — Antoine, *Conif.* 77, t. 30. — Hooker & Arnott, *Bot. Voy. Beechey*, 394. — Endlicher, *Syn. Conif.* 89. — Walpers, *Ann.* v. 798. — Dietrich, *Syn.* v. 393. — Courtin, *Fam. Conif.* 56. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 419. — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 674, t. 46, f. 1.

Picea bracteata, Loudon, *Arb. Brit.* iv. 2348, f. 2256 (1838). — Gordon, *Pinetum*, 145. — Lawson, *Pinetum Brit.* ii. 171, t. 25, 26, f. 1–7. — (Nelson) Senilis, *Pinaceæ*, 37. — Coleman, *The Garden*, xxxv. 12, f.

Taxodium sempervirens? Hooker, *Icon.* iv. t. 379 (not Lambert) (1841).

Abies bracteata, Nuttall, *Sylva*, iii. 137, t. 118 (1849). — Hartweg, *Jour. Hort. Soc. Lond.* iii. 226. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 209. — Carrière, *Traité Conif.* 196. — Hooker, *Bot. Mag.* lxxix. t. 4740. — Lemaire, *Ill. Hort.* i. t. 5. — Naudin, *Rev. Hort.* 1854, 31. — Planchon, *Fl. des Serres*, ix. 109, t. 899. — A. Murray, *Edinburgh New Phil. Jour.* n. ser. x. 1, t. 1, 2; *Gard. Chron.* 1859, 928; *Trans. Bot. Soc. Edinburgh*, vi. 211, t. 1, 2. — Henkel & Hochstetter, *Syn. Nadelh.* 167. — Sénéclauze, *Conif.* 7. — Hoopes, *Evergreens*, 199. — Bertrand, *Bull. Soc. Bot. France*, xviii. 379; *Ann. Sci. Nat.* sér. 5, xx. 95. — Engelmann, *Trans. St. Louis Acad.* iii. 601; *Gard. Chron.* n. ser. xii. 684; *Brewer & Watson Bot. Cal.* ii. 118. — Veitch, *Man. Conif.* 89, f. 14, 15. — Kellogg, *Forest Trees of California*, 27. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 213. — Masters, *Gard. Chron.* ser. 3; vii. 672, f. 112; *Jour. R. Hort. Soc.* xiv. 190. — Mayr, *Wald. Nordam.* 337, t. 9. — Beissner, *Handb. Nadelh.* 488, f. 138. — Hansen, *Jour. R. Hort. Soc.* xiv. 459 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 17. — Eastwood, *Erythea*, v. 73.

A tree, from one hundred to one hundred and fifty feet in height, with a trunk sometimes three feet in diameter, and comparatively short slender usually pendulous scattered branches furnished with long sinuous rather remote lateral branchlets sparsely clothed with foliage, and forming a broad-based pyramid which fifteen or twenty feet from the top is abruptly narrowed into a thin spire-like head, while the lowest branches often sweep the ground, unless the tree has been excessively crowded by its neighbors. The bark of the trunk, which is smooth and pale above, near the base of the tree is from one half to three quarters of an inch in thickness, light reddish brown, slightly and irregularly fissured and broken into thick closely appressed scales. The winter branch-buds are ovate, acute, from three quarters of an inch to an inch in length and from one quarter to one third of an inch in thickness, with very thin loosely imbricated pale chestnut-brown ovate acute boat-shaped scales increasing in size from below upward, the outer accrescent, persistent at the base of the young branch, and the inner united into a cup and deciduous in one piece. The branchlets are stout, glabrous, light reddish brown for three or four years, and covered during their first season with a glaucous bloom. The leaves are thin, flat, rigid, linear or linear-lanceolate, gradually or abruptly narrowed toward the base, which is enlarged into an oval disk, often falcate, especially on fertile branches, acuminate, with long slender stiff callous tips, dark yellow-green and lustrous and slightly rounded on the upper surface, which is marked below the middle with an obscure groove, and silvery white or on old leaves pale on the lower surface, with bands of from eight to ten rows of stomata occupying the space between the broad midrib and the thickened strongly revolute margins; they are remote, two-ranked from the conspicuous twist near their base, and spread at nearly right angles to the branchlets of lower sterile branches, or are somewhat ascending on upper fertile branches, and are from one inch and a half to two inches and a quarter long and from an eighth to a sixth of an inch wide, with resin ducts close to the epidermis and hypoderm cells in an interrupted band on the upper surface and at the angles and midrib; on leading shoots they are rounded on the upper surface, and, standing out almost at right angles, are more or less incurved above the middle, from an inch and a half to an inch and three quarters long and about an eighth of an inch wide. The flower-buds resemble the branch-buds in shape and in the texture and color of their scales, which become scarious and silvery white in the inner ranks, forming very conspicuous involucres at the base of the flowers, which open early in May. The buds of the staminate flowers are produced in great numbers near the base of the branchlets on branches from the middle of the tree upward, while those of the pistillate flowers appear near the ends of the branchlets of the upper branches only. The staminate flowers are cylindrical, from three quarters of an inch to an inch and a quarter long and a quarter of an inch in diameter, with pale yellow anthers which fade to a dark reddish brown and at maturity are suspended on slender pedicels often half an inch in length. The pistillate flowers are oblong and about an inch and a quarter in length, their scales being oblong, rounded above and nearly as long as their cuneate obcordate yellow-green bracts, with spreading lobes denticulate at the apex, and slender elongated erect slightly spreading or contorted or variously twisted awns. The cones, which are borne on stout peduncles sometimes half an inch in length covered by the scales of the flower-buds, vary from oval to subcylindrical in shape, and are full and rounded at the apex, glabrous and pale purple-brown, from three to four inches long and from an inch and a half to two inches thick, with thin scales strongly incurved above the body of their bracts, obtusely short-pointed at the apex, obscurely and unequally denticulate on the thin margins, full and rounded on the sides, which are gradually narrowed to the cordate base, and about one third longer than their oblong obovate obcordate pale yellow-brown bracts which terminate in flat rigid tips from an inch to an inch and three quarters long; from above the middle of the cone these point toward its apex, and are often closely appressed to its sides, and spreading below its middle frequently are much recurved toward its base. Firmly attached to the cone-scales, the bracts fall with these from the thick conical sharp-pointed axis of the cone. The seeds are dark red-brown, about three eighths of an inch in length and nearly as long as their oblong-obovate pale reddish brown lustrous wings, which are rounded at the apex.

Abies venusta in its scattered branches, its large long-pointed buds covered by thin loosely imbricated scales, its broad sharply pointed leaves which are never crowded and are alike on all parts of the tree, and in its glabrous cones with the long exserted awns of the bracts and thick central axes, differs more from the usual forms of the genus than any other Fir-tree. Of the species of Abies now known no other occupies such a small territory, for it grows only in a few isolated groves, the largest containing not more than two hundred trees, scattered along the moist bottoms of cañons, which in summer often become completely dry, usually at elevations of about three thousand feet on both slopes of the outer western ridge of the Santa Lucia Mountains in Monterey County, California, its associates being *Quercus chrysolepis, Quercus densiflora, Quercus Wislizeni, Arbutus Menziesii, Umbellularia Californica, Acer macrophyllum, Pinus Coulteri, Pseudotsuga mucronata, and Alnus rhombifolia.*[1]

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[1] The most southern point from which *Abies venusta* has been reported is in Bear Cañon, which faces the east, and is about twenty-five miles south of Los Burros Mines, near Punta Gorda, where there is a grove of about two hundred trees. It is scattered along the banks of the San Miguel Cañon on the eastern slope of the coast ridge, just south of the trail from King's City to Los Burros Mines, and grows in a cañon immediately north of the San Miguel Cañon, and in a cañon at the head of the Nacimiento, while ten miles farther north the presence of two trees has been reported. These stations are at elevations of about three thousand feet above the level of the sea, and I have been unable to hear of trees growing above six thousand feet, as described by Douglas (*Companion Bot. Mag.* ii. 152), or of the trees of which William Lobb wrote in 1853: —

The wood of *Abies venusta* is heavy, not hard, and coarse-grained; it is light brown tinged with yellow, with paler sapwood, and contains broad conspicuous resinous bands of small summer cells and numerous obscure medullary rays. The specific gravity of the absolutely dry wood is 0.6783, a cubic foot weighing 42.27 pounds. Although it is perhaps occasionally used for fuel, the inaccessibility and steepness of the cañons which this tree inhabits and the sparseness of the population of the region have prevented employment of the wood for other purposes.

Abies venusta was discovered[1] by Dr. Thomas Coulter[2] in 1831; in 1853 it was introduced by William Lobb[3] into English gardens. Fortunately this beautiful tree, one of the handsomest and most interesting of its race, has thus found a foothold in the Old World,[4] for the fires which are frequent and destructive in the forests of the dry coast ranges of southern California seem destined sooner or later to exterminate it from its last retreat in America.[5]

"Along the summit of the central ridges, and about the highest peaks, in the most exposed and coldest places imaginable, where no other Pine makes its appearance, it stands the severity of the climate without the slightest perceptible injury, growing in slaty rubbish which, to all appearance, is incapable of supporting vegetation. In such situations it becomes stunted and bushy, but even then the foliage maintains the same beautiful dark green color, and when seen at a distance it appears more like a handsomely grown Cedar than a Pine." (See *Gard. Chron.* 1853, 435.) Since Lobb's time fire has probably destroyed all the trees except those which were protected by the moisture in the bottoms of the deepest cañons.

[1] *Teste* Hooker, *Bot. Mag.* lxxix. t. 4740.

[2] See iii. 84.

[3] See x. 60.

[4] In sheltered positions in the milder parts of Great Britain and in northern Italy *Abies venusta* has grown rapidly and vigorously and has produced cones. The tallest specimen in England of which I have heard is at Eastnor Castle, in Herefordshire, where there is a tree over sixty feet in height (A. H. Kent *in litt.*). The largest specimen in the park at Tortworth Court, Gloucestershire, which was probably planted between 1856 and 1862, in May, 1897, was fifty-two feet in height, with a trunk two feet in diameter at one foot above the ground. (See *Gard. Chron.* ser. 3, xxi. 305.) Mr. Kent reports several other healthy specimens from forty to fifty feet in height in different parts of England and Scotland. For notes on *Abies venusta* in Europe, see, also, Fowler, *Gard. Chron.* 1879, 286. — Nicholson, *Garden and Forest*, ii. 567. — Masters, *Gard. Chron.* ser. 3, v. 242. — J. G. Jack, *Garden and Forest*, iv. 614.

In the eastern United States *Abies venusta* has not proved hardy in any part of the country where it has been tried.

[5] *Abies venusta* probably always grows slowly, as might be expected from the aridity of the region it inhabits. The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut by T. S. Brandegee in one of the cañons of the Santa Lucia Mountains facing the ocean, is twenty-four and three quarters inches in diameter inside the bark and one hundred and twenty-four years old, with an inch of sapwood consisting of forty-one layers of annual growth.

EXPLANATION OF THE PLATES.

Plate DCXV. Abies venusta.

1. A branch with staminate flowers, natural size.
2. A staminate flower, enlarged.
3. An anther, side view, enlarged.
4. An anther, seen from below, enlarged.
5. A branch with pistillate flowers, natural size.
6. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
7. A bract of a pistillate flower, lower side, enlarged.
8. A leaf, natural size.
9. Cross section of a leaf magnified fifteen diameters.
10. Winter-buds, natural size.

Plate DCXVI. Abies venusta.

1. A fruiting branch, natural size.
2. A cone-scale, lower side, with its bract, natural size.
3. A cone-scale, upper side, with its seeds and bract, natural size.
4. A seed, enlarged.
5. Axis of a cone, with its peduncle, natural size.

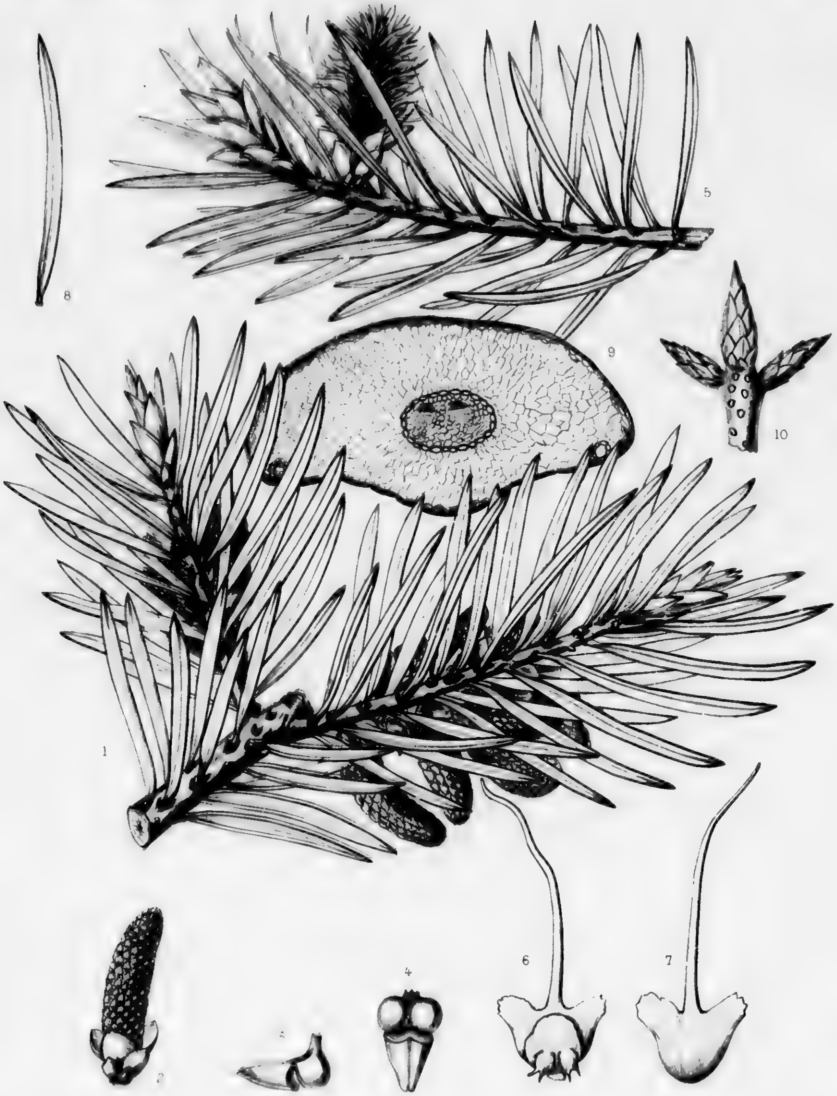
EXPLANATION OF THE PLATES

[illegible]

1. [illegible]
2. [illegible]
3. [illegible]
4. An anther, seen from below, enlarged.
5. A branch with pistillate flowers, natural size.
6. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
7. A bract of a pistillate flower, lower side, enlarged.
8. A leaf, natural size.
9. Cross section of a leaf magnified fifteen diameters.
10. Winter-buds, natural size.

Plate DCXVI. Abies venusta.

1. A fruiting branch, natural size.
2. A cone-scale, lower side, with its bract, natural size.
3. A cone-scale, upper side, with its seeds and bract, natural size.
4. A seed, enlarged.
5. Axis of a cone, with its peduncle, natural size.



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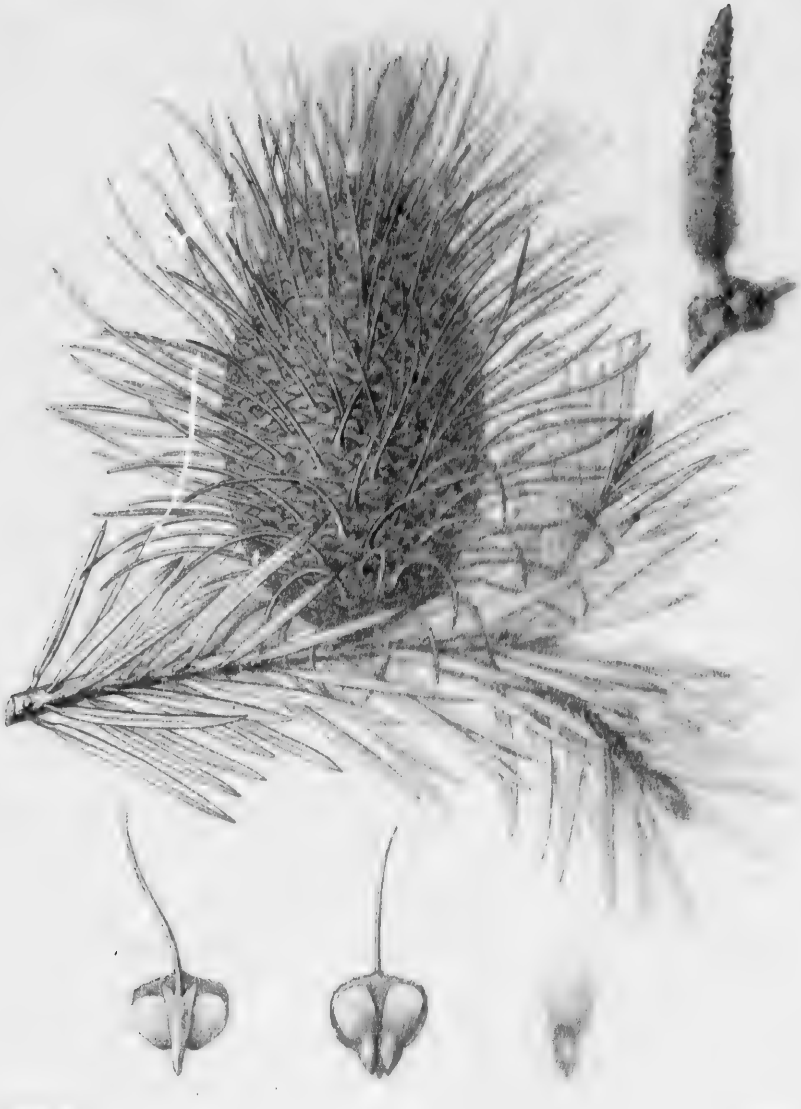
ABIES VENUSTA, K. Koch.

A. Riocreux direx.

Imp. J. Taneur Paris.



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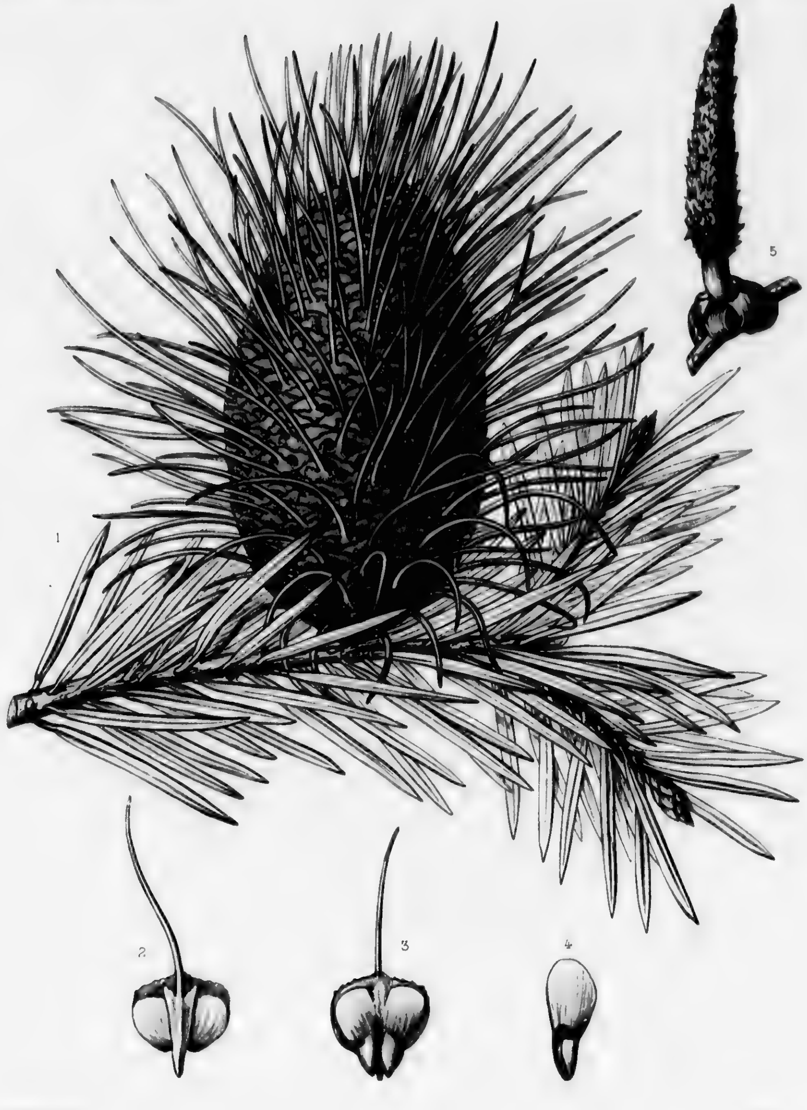

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ABIES NOBILIS.

Red Fir. Larch.

Bracts of the cone-scales spatulate, full, rounded, and fimbriate above, long-pointed, recurved, nearly covering their scales. Leaves light blue-green, distinctly grooved above, rounded and emarginate at the apex on lower branches, crowded, incurved, nearly equally 4-sided and acute on fertile branches.

Abies nobilis, Lindley, *Penny Cycl.* i. 30 (1833). — Forbes, *Pinetum Woburn.* 115, t. 40. — Link, *Linnæa*, xv. 532. — Lawson & Son, *Agric. Man.* 374. — Spach, *Hist. Vég.* xi. 419. — Nuttall, *Sylva*, iii. 136, t. 117. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 209. — Carrière, *Traité Conif.* 198. — Henkel & Hochstetter, *Syn. Nadelh.* 168. — Sénéclauze, *Conif.* 10. — K. Koch, *Dendr.* ii. pt. ii. 209. — Engelmann, *Trans. St. Louis Acad.* iii. 601 (in part); *Gard. Chron.* n. ser. xii. 684 (in part); *Brewer & Watson Bot. Cal.* ii. 119 (in part); *Bot. Gazette*, vii. 4. — Veitch, *Man. Conif.* 101. — Lauche, *Deutsche Dendr.* ed. 2, 83. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 214. — Masters, *Gard. Chron.* n. ser. xxiv. 652, f. 146; *Jour. Linn. Soc.* xxii. 188 (excl. hab. Mt. Shasta and var. *magnifica*); *Jour. R. Hort. Soc.* xiv. 193. — Syme, *Gard. Chron.* n. ser. xxv. 395. — Mayr, *Wald. Nordam.* 350. — Lemmon, *Rep. California State Board Forestry*, iii. 141 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 61; *Bull. Sierra Club*, ii. 164 (*Conifers of the Pacific Slope*). — Beissner, *Handb. Nadelh.* 484, f. 136, 137. — Hansen, *Jour. R. Hort. Soc.* xiv. 470 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 17.

Pinus nobilis, D. Don, *Lambert Pinus*, iii. t. (1837). — Hooker, *Fl. Bor.-Am.* ii. 162. — Antoine, *Conif.* 77, t. 29, f. 2. — Hooker & Arnott, *Bot. Voy. Beechey*, 394. — Endlicher, *Syn. Conif.* 90. — Lawson & Son, *List No. 10, Abietineæ*, 12. — Dietrich, *Syn.* v. 398. — Courtin, *Fam. Conif.* 57. — Parlatore, *De Candolle Prodr.* xvi. pt. ii. 419. — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 699, t. 49, f. 29, 29 a, b.

Picea nobilis, Loudon, *Arb. Brit.* iv. 2342, f. 2249, 2250 (1838). — Knight, *Syn. Conif.* 39. — Lindley & Gordon, *Jour. Hort. Soc. Lond.* v. 209. — Gordon, *Pinetum*, 149; Suppl. 48. — Newberry, *Pacific R. R. Rep.* vi. pt. iii. 49, 90, f. 17. — Lawson, *Pinetum Brit.* ii. 181, t. 28, 29, f. 1-18. — (Nelson) Senilis, *Pinaceæ*, 59.

Picea (Pseudotsuga) nobilis, Bertrand, *Ann. Sci. Nat.* sér. 5, xx. 86 (1874).

A tree, in old age[1] with a comparatively broad and somewhat rounded head, and usually from one hundred and fifty to two hundred and occasionally two hundred and fifty feet in height, with a massive trunk from six to eight feet in diameter, short rigid limbs disposed in regular remote whorls, and short stout remote lateral branches standing out at right angles, the ultimate divisions generally pointing forward and the whole forming great flat-topped masses of foliage. Until the tree is from eighty to one hundred feet in height the tapering stem is covered with thin smooth pale bark and clothed to the ground with branches which form a regular open pyramid gradually narrowed to the slender apex, but from the lower portion of the trunks of older trees the branches gradually fall, often leaving them naked for one hundred or one hundred and fifty feet when fully grown, the bark on the old trunks being from one to two inches in thickness, bright red-brown, and deeply divided into broad flat ridges irregularly broken by cross fissures and covered with thick closely appressed scales. The winter branch-buds are ovoid-oblong, about an eighth of an inch in length, and covered by ovate acute red-brown scales usually thickly coated with resin. The branchlets are comparatively slender, puberulous for four or five years, bright reddish brown during their first season, and then gradually grow darker. The leaves are marked on the upper surface with deep sharply defined grooves which sometimes do not reach quite to the apex, and are rounded and obscurely ribbed on the lower surface, stomatiferous above and below with numerous rows of stomata, dark or light blue-green, and often very glaucous during their first season, with generally a single fibro-vascular bundle, resin ducts close to the epidermis of the lower surface and midway between the edges and the midrib, and hypoderm cells in an interrupted band chiefly confined to the middle of the leaf on the upper and lower surfaces and to its edges; the leaves are crowded in several rows and are erect, those on the lower side of the branch by the twisting of their bases, shorter on the upper side than on the lower and strongly incurved with the points erect or pointing away from the end of the branch; on young plants and on the lower sterile branches of old trees they are flat, oblanceolate, rounded and usually slightly notched at the apex, from an inch to an inch and a half long and about a sixteenth of an inch wide; on fertile branches, where they are more crowded than on sterile branches, they are much thickened and often almost equally four-sided, acuminate and furnished at the apex with long rigid callous tips, and generally from one half to three quarters of an inch in length; and on leading shoots they are flat, gradually narrowed from the base, which is about an eighth of an inch wide, acuminate, with long rigid points, and about an inch long. The staminate flowers are cylindrical and from three quarters of an inch to an inch in length, with reddish purple anthers, and at maturity are suspended on slender pedicels from one quarter to nearly one half of an inch long. The pistillate flowers, which are mostly confined to the upper branches, but are often scattered over those below them, are cylindrical, from an inch to an inch and a half long, and from one quarter to one third of an inch in diameter, with broad rounded scales much smaller than their nearly orbicular bracts, which are erose on the margins and contracted above into slender elongated strongly reflexed tips. The cones are oblong-cylindrical, slightly narrowed, but full and rounded at the apex, from four to five inches long and from two to two and a half inches in diameter, purple or olive-brown and pubescent, with scales which are about one third wider than they are long, and gradually narrowed from the rounded apex to the base, or more often are full at the sides, rounded and denticulate above the middle and then abruptly contracted and wedge-shaped below; they are nearly or entirely covered by their strongly reflexed pale green bracts which are spatulate, full and rounded above and fimbriate on the margins, with broad foliaceous midribs produced above the body of the bract into short broad flattened points. The seeds are half an inch in length, pale reddish brown, and about as long as their wings, which are gradually narrowed from below to the nearly truncate slightly rounded apex.

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[1] The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, cut on the Cascade Mountains near Portland, Oregon, is twenty and one half inches in diameter inside the bark and two hundred and ninety-two years old, with sapwood three and one eighth inches thick and with one hundred and twelve layers of annual growth. It is probable, therefore, that trees of this species live, under favorable conditions, far beyond three hundred years, which has usually been considered the limit of the life of any of the American Fir-trees.

Abies nobilis inhabits the Cascade Mountains from the slopes of Mt. Baker in northern Washington[1] to the valley of the Mackenzie River in Oregon,[2] and the coast ranges from the northern slopes of the Olympic Mountains in Washington[3] as far south, at least, as the valley of the Nestucca River in Oregon. Probably attaining its largest size on the high coast mountains of Oregon, it is most abundant on the western slopes of the Cascade Range in Washington and northern Oregon, where it is common from elevations of two thousand five hundred up to five thousand feet above the sea, and forms the largest part of the forest between elevations of three and four thousand feet, mingling below with *Tsuga heterophylla*, *Pseudotsuga mucronata* and *Abies grandis*, and above with *Abies amabilis*, *Abies lasiocarpa* and *Tsuga Mertensiana*. On the eastern and northern slopes of the Cascade Mountains it is less abundant and of smaller size.

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[1] During the summer of 1897 *Abies nobilis* was found on the south side of Mt. Baker by Mr. A. J. Johnson. (See Coville, *Garden and Forest*, x. 517.)

As the northern end of the Cascade Mountains has been very little explored, *Abies nobilis* may be supposed to range somewhat to the north of Mt. Baker, which is the most northerly of the high volcanic peaks of the Cascades, and possibly to reach the borders of British Columbia.

The Fir found by Lyall on the Cascade Mountains, near Lake Chilukweyuk, and doubtfully referred by him to *Picea nobilis* (*balsamea?*) (*Jour. Linn. Soc.* vii. 143), may possibly have been *Abies nobilis* at a more northern station than it has since been seen, and north of the boundary of the United States, but I have not seen the specimen.

[2] See Coville, *l. c.*

[3] In August, 1896, I found a single small plant of *Abies nobilis* on a slope above the Solduc River at an elevation of three thousand feet above the sea and near the northern base of the Olympic Mountains, and the following year this species was seen by Dr. C. Hart Merriam in the same region.

The wood of *Abies nobilis* is light, hard, strong, and rather close-grained; it is pale brown streaked with red, with rather darker colored sapwood, and contains broad conspicuous dark-colored resinous bands of small summer cells and thin obscure medullary rays. The specific gravity of the absolutely dry wood is 0.4561, a cubic foot weighing 28.42 pounds. Occasionally manufactured into lumber, it is used under the name of larch for the interior finish of buildings and for packing-cases.

Abies nobilis was discovered on the Cascade Mountains just south of the Columbia River, in September, 1825, by David Douglas, on a day made memorable also by his discovery of *Abies amabilis*.[1]

Sent by Douglas to England, *Abies nobilis* at once became a popular ornament of European parks, in which it has already grown to a large size and produced its beautiful cones in profusion.[2] On the Atlantic seaboard it has grown well in the middle states,[3] and proved hardy in sheltered positions in eastern Massachusetts, where, however, it gives little promise of growing to a large size or of displaying much of the beauty and vigor which make this Fir-tree one of the stateliest and most splendid inhabitants of the forests of the northwestern states.

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[1] Douglas, *Companion Bot. Mag.* ii. 93. See, also, Sargent, *Gard. Chron.* n. ser. xvi. 7.

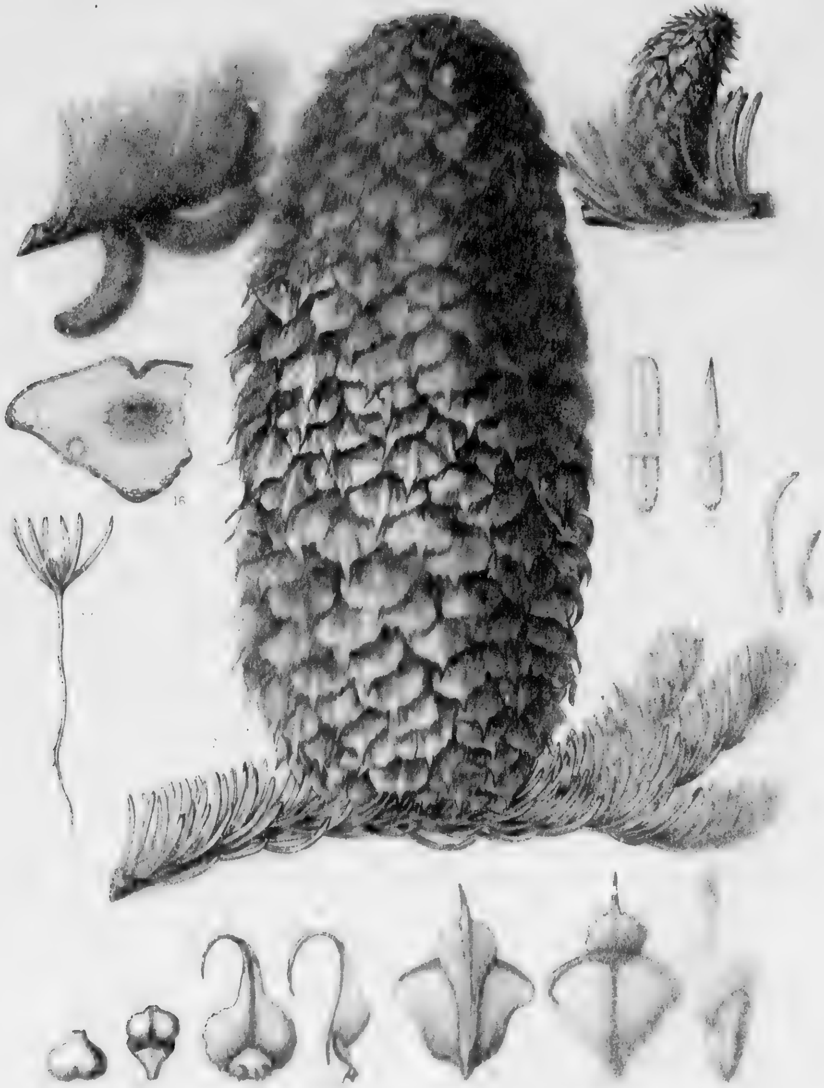
[2] The specimen in the Pinetum at Dropmore, near Windsor, in England, planted where it now stands in 1837, was seventy-one feet in height in 1893, with its lower branches still sweeping the ground (J. G. Jack, *Garden and Forest*, vi. 14); and at Birr Castle, King's County, Ireland, in 1891, there was a specimen eighty-three feet in height. (See Dunn, *Jour. R. Hort. Soc.* xiv. 86. For other notes on *Abies nobilis* in Europe, see Hooker, *Jour. Bot. and Kew Gard. Misc.* ix. 85. — Hutchinson, *Trans. Highland and Agric. Soc.* ser. 4, xi. 24. — *Gard. Chron.* n. ser. xix. 14, f. 2; ser. 3, xx. 274, f. 52. — Webster, *Trans. Scottish Arboricultural Soc.* xi. 61.)

[3] See *Garden and Forest*, vi. 458.

EXPLANATION OF THE PLATE.

PLATE DCXVII. ABIES NOBILIS.

1. A branch with staminate flowers, natural size.
2. An anther, end view, enlarged.
3. An anther, seen from below, enlarged.
4. A branch with pistillate flowers, natural size.
5. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
6. Vertical section of a scale of a pistillate flower, with its bract and ovules, enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds and bract, natural size.
10. A seed, enlarged.
11. An embryo, enlarged.
12. A leaf of a sterile branch divided transversely, upper side, enlarged.
13. A leaf of a leading shoot divided transversely, lower side, enlarged.
14. A leaf of a lower sterile branch, natural size.
15. A leaf of a cone-bearing branch, natural size.
16. Cross section of a leaf of a fertile branch, magnified fifteen diameters.
17. A seedling plant, natural size.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EXPLANATION OF THE PLATE

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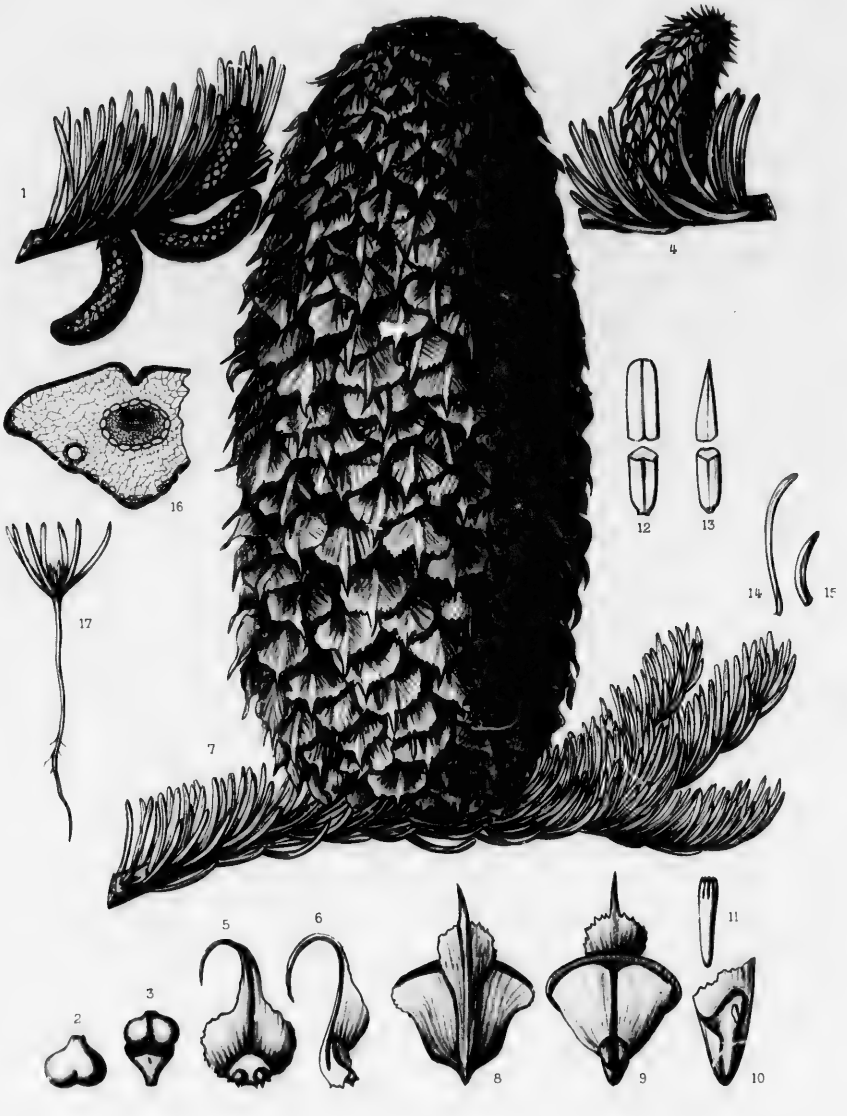
1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. A [illegible] of a pistillate [illegible] upper [illegible] enlarged.
6. [illegible] section of a scale of a pistillate flower, with [illegible] and [illegible] enlarged.
7. A fruiting branch, natural size.
8. A cone-scale, lower side, with its bract, natural size.
9. A cone-scale, upper side, with its seeds and bract, natural size.
10. A seed, enlarged.
11. An embryo, enlarged.
12. A leaf of a sterile branch divided transversely, upper side, enlarged.
13. A leaf of a leading shoot divided transversely, lower side, enlarged.
14. A leaf of a lower sterile branch, natural size.
15. A leaf of a cone-bearing branch, natural size.
16. Cross section of a leaf of a fertile branch, magnified fifteen diameters.
17. A seedling plant, natural size.



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ABIES MAGNIFICA.

Red Fir.

Bracts of the cone-scales oblong-spatulate, acute, short-pointed, shorter than their scales. Leaves blue-green and often glaucous, tetragonal, bluntly pointed on sterile and acute, crowded and incurved on fertile branches.

Abies magnifica, A. Murray, *Proc. R. Hort. Soc.* iii. 318, f. 25–33 (1863); *Gartenflora*, xiii. 119. — Henkel & Hochstetter, *Syn. Nadelh.* 419. — K. Koch, *Dendr.* ii. pt. ii. 213. — Engelmann, *Trans. St. Louis Acad.* iii. 601; *Gard. Chron.* n. ser. xii. 685, f. 116; *Brewer & Watson Bot. Cal.* ii. 119; *Bot. Gazette*, vii. 4. — Veitch, *Man. Conif.* 99. — Sargent, *Forest Trees N. Am. 10th Census U. S.* ix. 214; *Gard. Chron.* n. ser. xxv. 20. — Masters, *Gard. Chron.* n. ser. xxiv. 652, f. 148; *Jour. R. Hort. Soc.* xiv. 193. — Syme, *Gard. Chron.* n. ser. xxv. 895. — Mayr, *Wald. Nordam.* 351. — Lemmon, *Rep. California State Board Forestry*, iii. 142, t. 18 (*Cone-Bearers of California*); *West-American Cone-Bearers*, 61; *Bull. Sierra Club*, ii. 165 (*Conifers of the Pacific Slope*). — Beissner, *Handb. Nadelh.* 492, f. 135. — Hansen, *Jour. R. Hort. Soc.* xiv. 469 (*Pinetum Danicum*). — Koehne, *Deutsche Dendr.* 17. — Merriam, *North American Fauna*, No. 7, 340 (*Death Valley Exped.* ii.). — Coville, *Contrib. U. S. Nat. Herb.* iv. 224 (*Bot. Death Valley Exped.*).

Picea magnifica, Gordon, *Pinetum*, ed. 2, 219 (1867). — A. Murray, *Gard. Chron.* n. ser. iii. 105, 752, f. 156.

Pinus amabilis, Parlatore, *De Candolle Prodr.* xvi. pt. ii. 426 (in part) (not Antoine) (1868). — W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. t. 46, f. 3–3 a.

Abies amabilis, Vasey, *Rep. Dept. Agric. U. S.* 1875, 34 (*Cat. Forest Trees U. S.*) (not Forbes) (1876).

Pinus magnifica, W. R. M'Nab, *Proc. R. Irish Acad.* ser. 2, ii. 700, t. 49, f. 30, 30 a (1877).

Abies nobilis, Engelmann, *Gard. Chron.* n. ser. xii. 684 (in part) (not Lindley) (1879); *Brewer & Watson Bot. Cal.* ii. 119 (in part). — Kellogg, *Trees of California*, 33 (in part).

Abies nobilis, var. **magnifica**, Kellogg, *Trees of California*, 35 (1882). — Masters, *Jour. Linn. Soc.* xxii. 189, t. 5, f. 19–21.

A tree, in old age[1] occasionally somewhat round-topped and often two hundred and fifty feet in height, with a trunk eight or ten feet in diameter and often naked for half the height of the tree, and comparatively small and short branches arranged in regular remote whorls, the upper slightly ascending and the lower somewhat pendulous and furnished with rigid remote lateral branches, the ultimate divisions pointing forward and the whole forming great broad stiff flat-topped frond-like masses of foliage. Until it is about one hundred feet high the tapering trunk of *Abies magnifica*, like its branches, is covered with thin smooth silvery white bark which, as the tree grows older, begins to darken near the ground; and, when fully grown, the bark of the trunk is from four to six inches thick and is deeply divided into broad rounded ridges broken by cross fissures and covered by dark red-brown scales which in falling disclose the bright cinnamon-red inner bark. The winter branch-buds are ovate, acute, and from one quarter to one third of an inch long and are covered with bright chestnut-brown scales, those of the outer ranks being denticulate on the margins, with prominent midribs produced into short tips. The branchlets are stout, light yellow-green and slightly puberulous during their first season, and then light red-brown and lustrous for seven or eight years, finally becoming gray or silvery white. The leaves, which are persistent usually for about ten years and are pale and very glaucous during their first season, and later become blue-green, are almost equally four-sided, ribbed above and below, with from six to eight rows of stomata on each of the four sides, generally two fibro-vascular bundles, resin ducts close to the epidermis and midway between the sides and the midrib of the lower surface, and hypoderm cells at the four angles; on young plants and the lower branches of older ones they are oblanceolate, somewhat flattened, rounded or bluntly pointed at the apex, from three quarters of an inch to an inch and one half long and one sixteenth of an inch wide, those on the lower side of the branch spreading in two nearly horizontal ranks by the twist at their base, while those on the upper side of the branch, which are curved from below the middle, are often almost erect or bent forward at various angles to the branch; on upper and especially on fertile branches the leaves are much thickened, with more prominent midribs, acute, with short callous tips, from one third of an inch in length on the upper side of the branch to an inch and a quarter on the lower side, crowded, erect and strongly incurved, completely hiding the upper side of the branch; and on leading shoots the leaves are about three quarters of an inch long, arcuate, and acuminate, with their long rigid callous spinescent tips pressed against the stem. The staminate flowers are oblong-cylindrical, from one half to three quarters of an inch long and about a quarter of an inch thick, with dark reddish purple anthers. The pistillate flowers are oblong, an inch and a half long and nearly an inch thick, with rounded scales much shorter than their oblong pale green bracts which terminate in elongated slender tips more or less tinged with red. The cones are oblong-cylindrical, slightly narrowed to the rounded truncate or retuse apex, dark purplish brown,[1] puberulous, from six to nine inches long and from two and a half to three and a half inches in diameter, with scales often an inch and a half wide and usually about two thirds as wide as they are long, gradually narrowed to the cordate base, somewhat longer or often only two thirds as long as their bracts, which are oblong-spatulate, acute or acuminate, with slender tips, slightly serrate above the middle and often abruptly contracted and then enlarged toward the base. The seeds are dark reddish brown, three quarters of an inch long and about as wide as their lustrous rose-colored obovate cuneate wings, which are nearly truncate and often three quarters of an inch wide at the apex.[2]

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[1] The log specimen in the Jesup Collection of North American Woods in the American Museum of Natural History, New York, which is only twenty-five inches in diameter inside the bark, is two hundred and sixty-one years old, with sapwood three eighths of an inch thick and ninety-seven years old.

Abies magnifica is distributed southward from southern Oregon,[3] finding its most northerly home on the Cascade Mountains, where it is common at elevations of between five and seven thousand feet above the sea, forming sometimes nearly pure forests or mingled with *Tsuga Mertensiana* at its upper limits, and below with *Pinus contorta* and *Pinus ponderosa.* It is common on the Trinity, Scott, and other cross ranges, and on the high peaks of the coast range of northern California;[1] on the slopes of Mt. Shasta, at elevations of between six thousand five hundred and eight thousand feet above the sea, it is the principal inhabitant of great forests in which *Abies concolor*, its constant companion at low elevations, often appears; southward it extends along the entire length of the western slope of the Sierra Nevada, on which it is the principal tree in the forest belt between elevations of six and nine thousand feet above the sea, sometimes descending in cool shady cañons a thousand feet lower; toward the southern end of the range it ascends to elevations of over ten thousand feet, although above eight thousand five hundred feet, where it attains its largest size on the fine soil of moraines and often forms continuous nearly pure forests, it is scattered and usually of smaller size;[2] it is also abundant on the eastern slope of the northern and central parts of the Sierra range at high elevations and on the Washoe Mountains, one of its eastern spurs in Nevada.[3]

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[1] Mr. J. G. Lemmon has found in the neighborhood of Meadow Lake, Sierra County, California, small and evidently stunted trees of *Abies magnifica*, with cones averaging four or five inches in length, which he describes as "of a yellowish color until maturity" (*Abies magnifica*, var. *xanthocarpa*, Lemmon, *Rep. California State Board Forestry*, iii. 145, t. 14 [*Cone-Bearers of California*] [1890]; *West-American Cone-Bearers*, 63; *Bull. Sierra Club*, ii. 166 [*Conifers of the Pacific Slope*]).

[2] On the Cascade Mountains of Oregon, on Mt. Shasta and on the cross and coast ranges of northern California, the bracts of the cone-scales of *Abies magnifica* are full and rounded or obtusely pointed and not acute at the apex, and are nearly as long or usually longer than their scales, the exserted bracts becoming bright golden brown at maturity in their exposed parts and loosely reflexed, leaving a considerable part of the scales of the cone uncovered. This is: —

Abies magnifica, var. *Shastensis*, Lemmon, *Rep. California State Board Forestry*, iii. 145 (*Cone-Bearers of California*) (1890); *West-American Cone-Bearers*, 62, t. 11.

? *Abies nobilis robusta*, Carrière, *Traité Conif.* ed. 2, 269 (1867). — Masters, *Gard. Chron.* n. ser. xxiv. 652, f. 147; *Jour. Linn. Soc.* xxii. 192, t. 5.

Abies nobilis, var. *glauca*, Masters, *Jour. Linn. Soc.* xxii. 189, f. 18 (1887).

Abies Shastensis, Lemmon, *Garden and Forest*, x. 184 (1897); *Bull. Sierra Club*, ii. 165 (*Conifers of the Pacific Slope*). — Coville, *Garden and Forest*, x. 516.

The plant figured by Dr. Masters as *Abies nobilis robusta* is evidently of this form, but the plant previously described by Carrière under this name had not fruited, and it is impossible to decide from his description whether it was the form with included or exserted bracts, and his varietal name, which is much older than Lemmon's *Shastensis*, cannot therefore be safely adopted.

At the lowest elevations on Mt. Shasta, where this tree is found, the cones are of the normal size and shape of the species, and the bracts, although full and rounded at the apex, are not exserted or protrude but slightly beyond the scales; at higher elevations the cones are often oval in form and not more than four inches long and two and a half inches in diameter, with comparatively longer and much exserted bracts. On the southern Sierra Nevada at very high elevations the bracts of the cones of individual trees of *Abies magnifica* are identical in their shape with those of the north and are much exserted, but in all the central part of the range occupied by this tree its cone-bracts are acute and included; and, except in the shape and length of the cone-bracts and in the oval form of the smaller cones produced on trees growing at high altitudes, I can find no characters to distinguish from the Fir of the central Sierra Nevada the var. *Shastensis*, which is the only form from Mt. Shasta northward. In habit, bark, and foliage the two forms seem identical, nor have I seen trees with cone-bracts which appeared intermediate in form between those of the species and its variety.

[3] See Coville, *l. c.*

The most northern point where *Abies magnifica*, var. *Shastensis*, was seen by Dr. Coville in 1897 was on the mountains east of Odell Lake and south of Davis Lake, at a point many miles south of the most southern station at which *Abies nobilis* has been observed (Coville, *l. c.*).

The wood of *Abies magnifica* is light, soft, not strong, comparatively durable in contact with the soil, but difficult to season; it is light red-brown, with thick somewhat darker sapwood and a satiny surface, and contains broad conspicuous dark-colored bands of small summer cells and numerous thin medullary rays. The specific gravity of the absolutely dry wood is 0.4701, a cubic foot weighing 29.30 pounds. It is largely used for fuel, and in California is occasionally manufactured into coarse lumber employed in the construction of cheap buildings and for packing-cases.

Abies magnifica was discovered by Frémont in December, 1845, during his second journey to California, probably on the Sierra Nevada.[4] The variety *Shastensis* was discovered on Mt. Shasta by Jeffrey in October, 1852.[5] Introduced into Europe nearly fifty years ago,[6] *Abies magnifica* has grown well in many parts of Great Britain[7] and in France and northern Italy; in the eastern United States it is hardy in sheltered positions as far north as eastern Massachusetts, but, like many other trees of western North America, it gives little promise of long life on the Atlantic seaboard.

Beautiful in its early years in its symmetrical shape and in its coloring, and massive and superb in its prime, with its tall dark stem and narrow crown, through which the light filters softly to the ground, hardly interrupted by its slender branches and their embracing leaves, the great Red Fir, the noblest of all its race, is a fit associate of the Sequoia, the Sugar Pine, the Yellow Pine, the Libocedrus, and the Douglas Spruce in the forests of the Sierra Nevada which these trees make glorious.

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[1] On Snow Mountain in Lake County, *Abies magnifica*, var. *Shastensis*, is the most abundant tree above elevations of six thousand feet. (See K. Brandegee, *Zoë*, iv. 176 [as *Abies nobilis*].)

[2] Muir, *The Mountains of California*, 173, f.

[3] Muir, *in litt.*

[4] *Teste* Herb. Engelmann.

[5] *Teste* Herb. Engelmann.

[6] *Abies magnifica* is said to have been introduced into England in 1851. (See Nicholson, *Gard. Dict.*) Jeffrey, perhaps, first sent the seeds to England, but probably of the var. *Shastensis*, as he does not appear to have visited the central Sierra Nevada. There was so much confusion, however, about the origin, the true character, and the names of many of the Pacific coast conifers when they were introduced into England, that it is hardly possible to decide who first sent the seeds of this tree to Europe.

[7] *Abies magnifica* is believed to be one of the hardiest of all the Fir-trees in Great Britain, where there are a number of specimens which, in 1892, were from thirty-five to forty feet in height. (See Dunn, *Jour. R. Hort. Soc.* xiv. 84.)

EXPLANATION OF THE PLATES.

PLATE DCXVIII. ABIES MAGNIFICA.

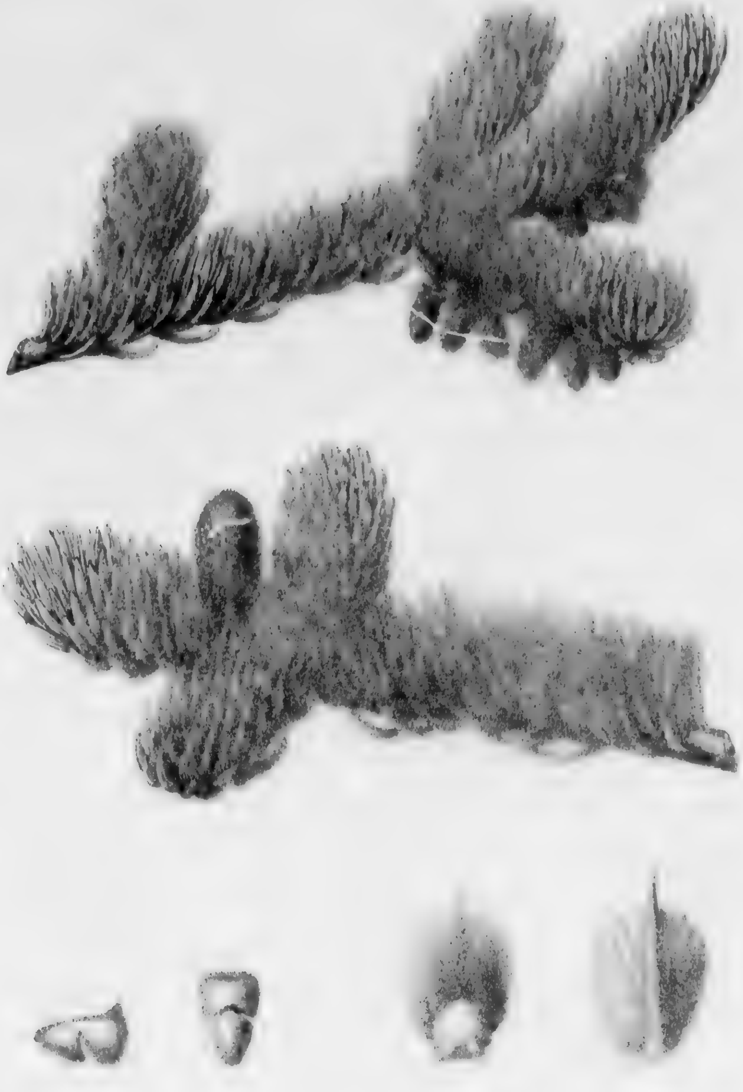
1. A branch with staminate flowers, natural size.
2. An anther, side view, enlarged.
3. An anther, front view, enlarged.
4. A branch with pistillate flowers, natural size.
5. A scale of a pistillate flower, upper side, with its bract and ovules, enlarged.
6. A bract of a pistillate flower, lower side, enlarged.

PLATE DCXIX. ABIES MAGNIFICA.

1. A fruiting branch, natural size.
2. A cone-scale, lower side, with its bract, natural size.
3. A cone-scale, upper side, with its seeds, natural size.
4. A seed, natural size.
5. Vertical section of a seed, enlarged.
6. An embryo, enlarged.
7. A leaf of a sterile branch divided transversely, enlarged.
8. A leaf from the upper side of a cone-bearing branch, natural size.
9. A leaf from the lower side of a cone-bearing branch, natural size.
10. A leaf from a sterile branch of a young tree, natural size.
11. End of a leading shoot, natural size.
12. Cross section of a leaf, magnified fifteen diameters.
13. Seedling plants, natural size.

PLATE DCXX. ABIES MAGNIFICA, *var.* SHASTENSIS.

1. A fruiting branch, natural size.
2. A cone-scale, lower side, with its bract, natural size.
3. A cone-scale, upper side, with a seed, natural size.
4. A seed, natural size.



ABIES [illegible]

EXPLANATION OF THE PLATES.

PLATE DCXVIII. ABIES MAGNIFICA.

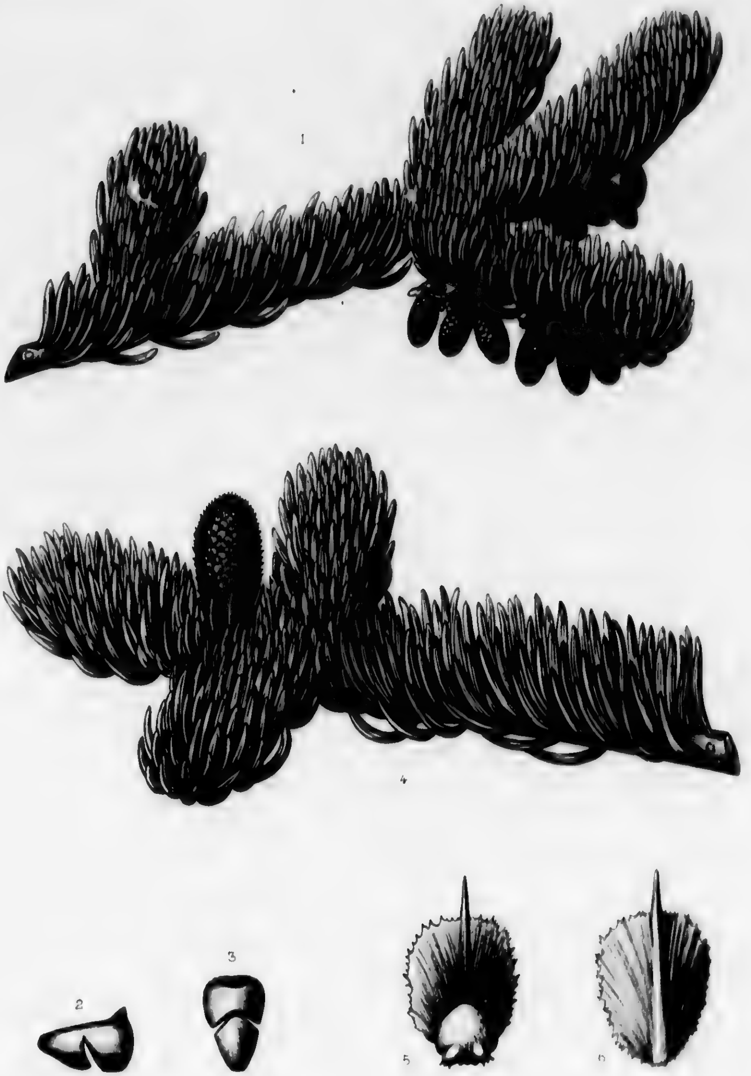
1. A branch with staminate flowers, natural size.
2. An anther, side view, enlarged.
3. An anther, front view, enlarged.
4. A [illegible] size.
5. [illegible] its bract and ovules, enlarged.
6. A [illegible] enlarged.

PLATE DCXIX. ABIES MAGNIFICA.

1. [illegible]
2. [illegible]
3. [illegible]
4. A seed, natural size.
5. Vertical section of a seed, enlarged.
6. An embryo, enlarged.
7. A leaf of a sterile branch divided transversely, enlarged.
8. A leaf from the upper side of a cone-bearing branch, natural size.
9. A leaf from the lower side of a cone-bearing branch, natural size.
10. A leaf from a sterile branch of a young tree, natural size.
11. End of a leading shoot, natural size.
12. Cross section of a leaf, magnified fifteen diameters.
13. Seedling plants, natural size.

PLATE DCXX. ABIES MAGNIFICA, *var.* SHASTENSIS.

1. A fruiting branch, natural size.
2. A cone-scale, lower side, with its bract, natural size.
3. A cone-scale, upper side, with a seed, natural size.
4. A seed, natural size.



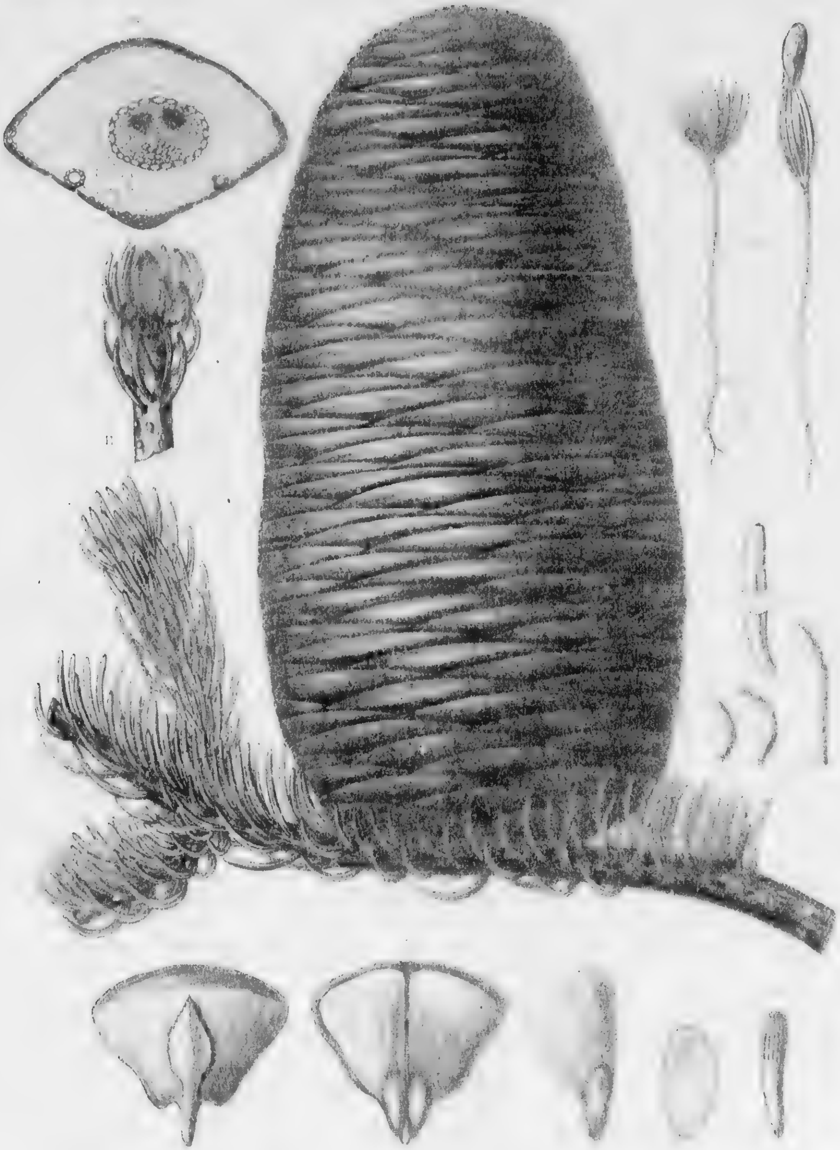
C. E. Faxon del.

Rapine sc.

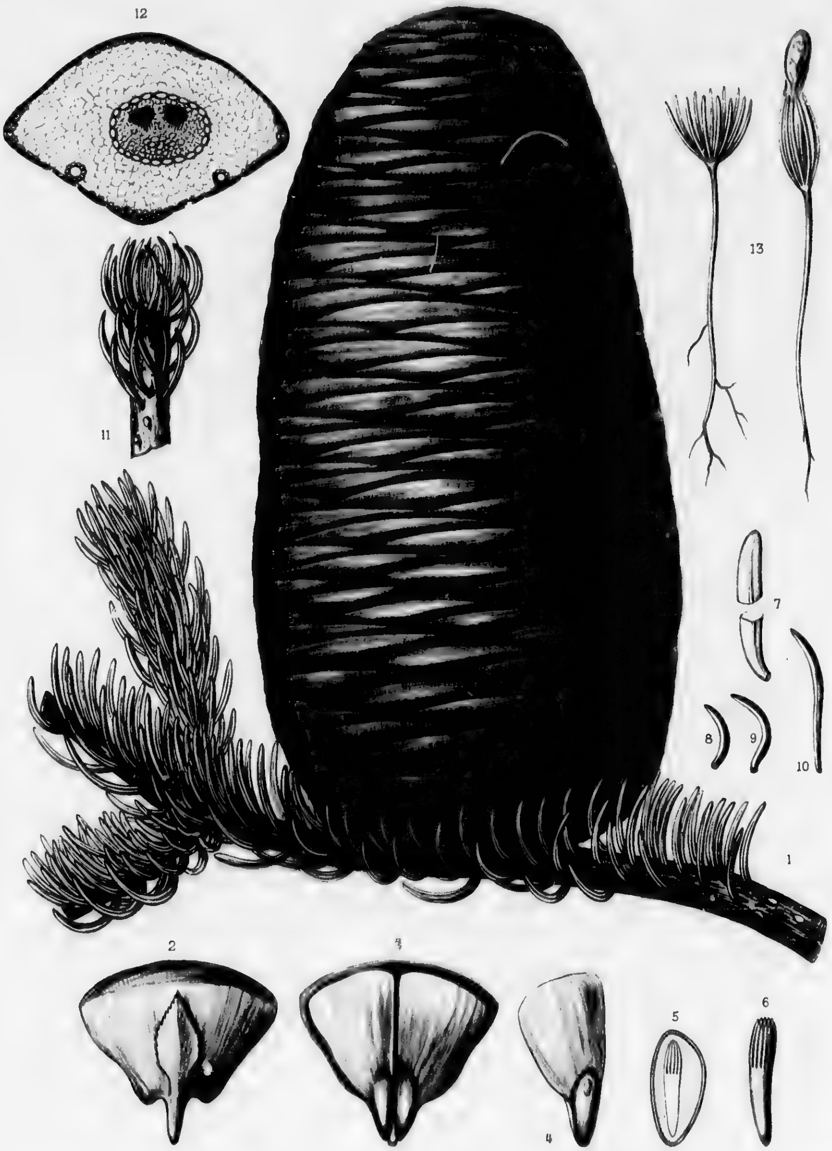
ABIES MAGNIFICA, A. Murr.

A. Riocreux direx.t

Imp. J. Taneur Paris



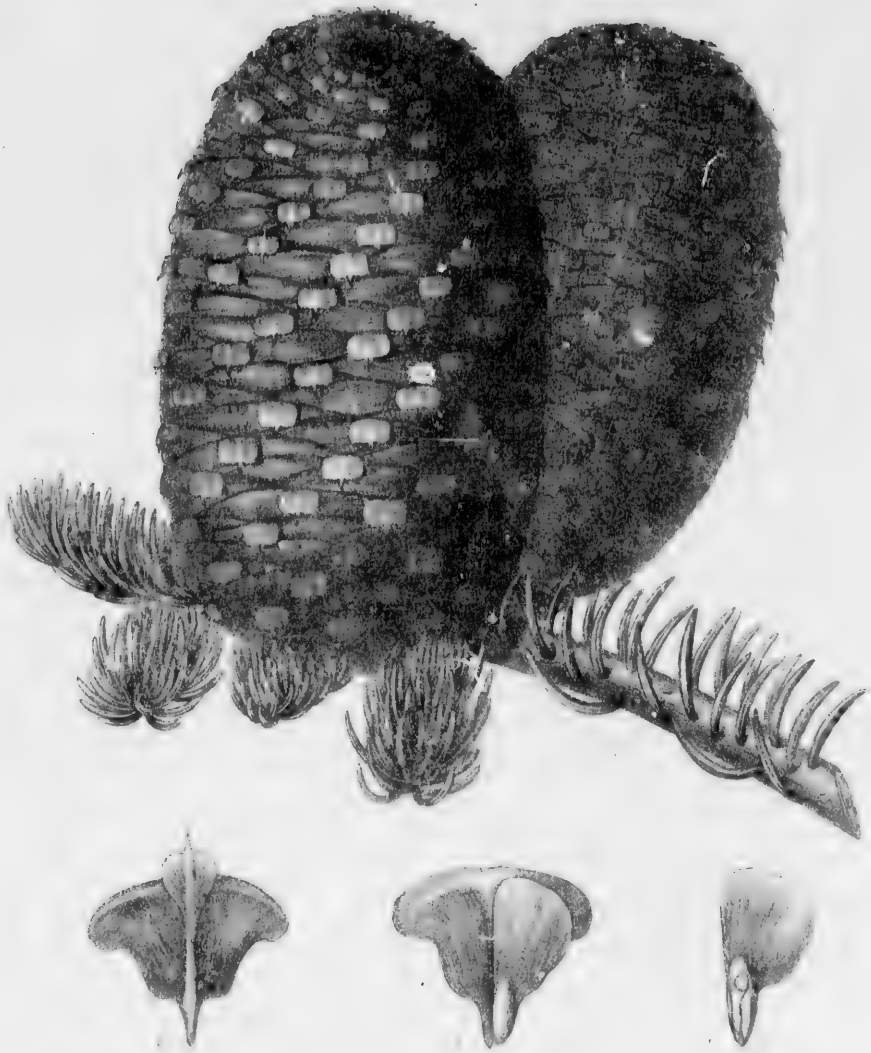
Abies [illegible]



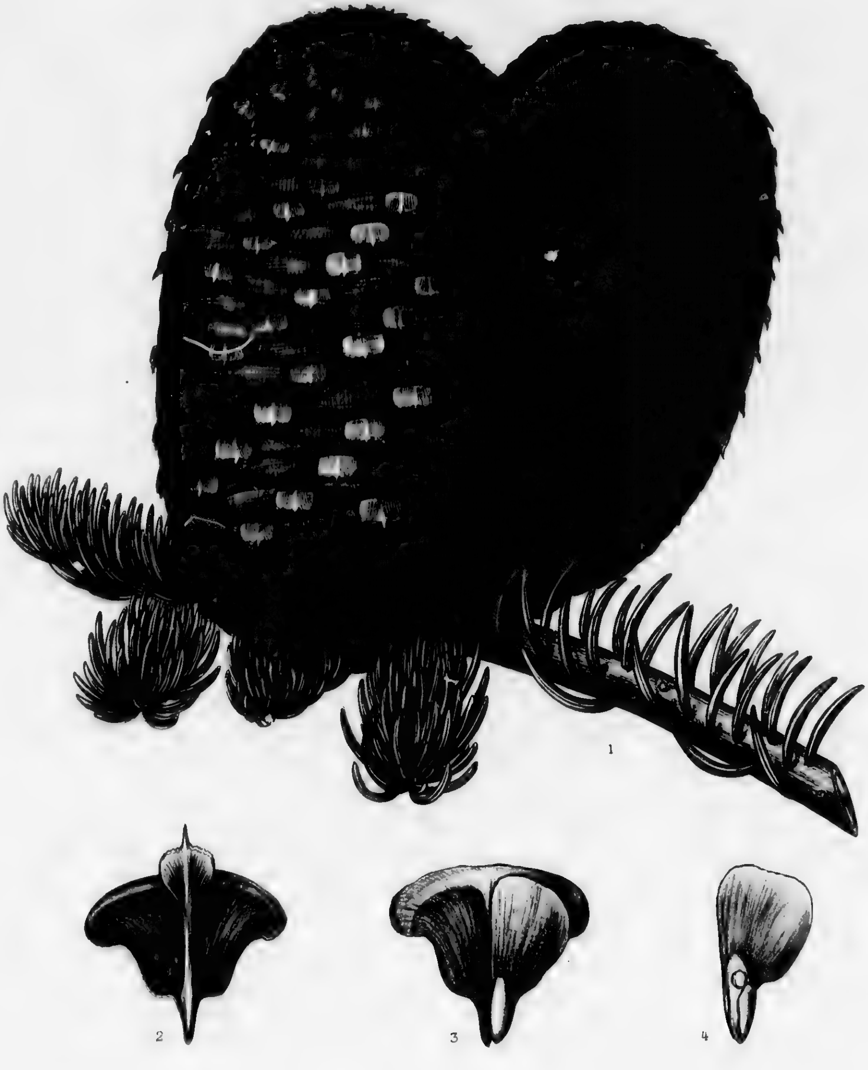
C. E. Faxon del. Rapine sc.

ABIES MAGNIFICA, A. Murr.

A. Riocreux direx.t Imp. J. Taneur, Paris.



ABIES MAGNIFICA, var. SHASTENSIS, [illegible]



C. E. Faxon del. *Rapine sc.*

ABIES MAGNIFICA, var. SHASTENSIS, Lemm.

A. Riocreux direx.t *Imp. J. Taneur Paris.*

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